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# ECONOMIC GEOGRAPHY

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## JANUARY

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ROTTERDAM AND WATERWAY APPROACHES TO THE RHINE
F. W. Morgan

GEOGRAPHY OF GRANT COUNTY, WASHINGTON
Elbert E. Miller

LEEDS AND THE YORKSHIRE WOOLLEN INDUSTRY
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CZECHOSLOVAKIA'S TERRITORIAL AND POPULATION CHANGES
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AUSTRIA: HER RAW MATERIALS AND INDUSTRIAL POTENTIALITIES
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"HIGH FARMING" IN SOUTHWESTERN ENGLAND, 1840–1880
G. E. Fussell

ALUMINUM RESOURCES OF THE UNITED STATES
James E. Collier

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# ECONOMIC GEOGRAPHY

## CONTENTS FOR JANUARY, 1948


ROTTERDAM AND WATERWAY APPROACHES TO THE RHINE . . . . . 1
F. W. MORGAN

GEOGRAPHY OF GRANT COUNTY, WASHINGTON . . . . . 19
ELBERT E. MILLER

LEEDS AND THE YORKSHIRE WOOLLEN INDUSTRY . . . . . 28
HENRY REES

CZECHOSLOVAKIA'S TERRITORIAL AND POPULATION CHANGES . . . . . 35
JOHN SHUTE

AUSTRIA: HER RAW MATERIALS AND INDUSTRIAL POTENTIALITIES . . . . . 45
GEORGE W. HOFFMAN

"HIGH FARMING" IN SOUTHWESTERN ENGLAND, 1840–1880 . . . . . 53
G. E. FUSSELL

ALUMINUM RESOURCES OF THE UNITED STATES . . . . . 74
JAMES E. COLLIER



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# Ellsworth Huntington

After a long, useful career in the field of Geography, Ellsworth Huntington is dead. His genial personality, his friendly interest in everybody's welfare and activities, his patience and fairness in discussion and argument, will no longer distinguish geographers' meetings. His eager search for truth, his productive writing, his publication, are ended. A great man, dean of American geographers, is gone.

Ellsworth Huntington was a founder of American geography, one of its leaders over many years. With Ellen Churchill Semple, William Morris Davis, Albert Perry Brigham, Curtis Frederick Marbut, and a very few others like them, he led in research in the field of geography, in formulating principles of the science, and in educating the pioneer American public and teaching profession to the value of geographic training for citizen, teacher, statesman, and soldier. Since Miss Semple's death, he has ranked foremost of American geographers, renowned throughout the world for keenness of mind, scientific curiosity, and skill and leadership in research. Always he was firm friend and sage counselor to ECONOMIC GEOGRAPHY.

Now that he is gone, others will assume the leadership he held so long. Younger men and women are moving forward in the rapidly expanding field to take over that leadership, but none has as yet shown the zeal and persistence in research, the depth and breadth of knowledge, that marked Ellsworth Huntington's long and busy career. By his death, Geography has lost not only one of its great world figures and leaders, but one of its best friends and most productive scientists; no coronach can adequately express our sense of loss!

ECONOMIC GEOGRAPHY

VOL. 24 JANUARY, 1948 NO. 1

# ROTTERDAM AND WATERWAY APPROACHES TO THE RHINE

*F. W. Morgan*

IN 1938 fifty-seven million metric tons of cargo passed along the Rhine at the Dutch frontier, a tonnage exceeding the tonnage of cargo passing along any other barge waterway in the world, and surpassed in non-ocean traffic only by movement through the Sault Ste. Marie canals and the Detroit river. (Except where otherwise stated, all tonnage figures are given in metric tons.) Farther up the Rhine lie ports which challenged comparison with the greatest seaports of Europe in the magnitude of their traffic. Duisburg-Ruhrort, the largest of all, handled 34,300,000 tons of cargo in 1937, or 40 per cent more than the sea-borne cargo passing through Hamburg. Twenty-three other German inland ports on the Rhine or its near connections each handled more than 1,000,000 tons, when only seven German seaports attained as much. The Rhine made Strasbourg the second largest waterway port of France, with traffic exceeding sea-borne cargo of Rouen or Marseilles, and permitted the Swiss river port of Basel to handle as much cargo as many moderate-sized seaports.

This river traffic has grown steadily in the last hundred years, but the greatest expansion occurred during the period 1900–13. After the war of 1914–18 the tendency continued, for new commodities like petroleum were added to the trade, and the considerable replacement of Lorraine ores by Swedish ores in consumption of the Ruhr furnaces involved increase in transshipment at seaports.

TABLE I

GROWTH OF TRAFFIC (BOTH WAYS) ON THE RHINE AT THE NETHERLANDS-GERMAN FRONTIER

(Thousands of tons)

| | | | |
|---|---|---|---|
| 1860 | 1,045 | 1929 | 54,500 |
| 1880 | 3,674 | 1932 | 32,322 |
| 1890 | 5,849 | 1937 | 59,000 |
| 1900 | 13,132 | 1938 | 57,000 |
| 1913 | 37,500 | 1939 | 46,587* |

*Carrying capacity of laden craft.

From: A. Sartorius von Waltershausen, *Deutsche Wirtschaftsgeschichte 1815–1914*, p. 109, 2nd ed. (Jena, 1923); A. Demangeon, L. Febvre, *Le Rhin*, p. 257 (Paris, 1935); *Jaarcijfers voor Nederland*, 1940, p. 194 ('s Gravenhage, 1942).

After the peak of 1929 came decline during the economic depression, but a new high level was attained in 1937, partly as result of the German programme of rearmament.

The total passing the Netherlands frontier at Lobith in 1938 was divided as follows (in thousands of tons):

TABLE II

| | *Direct (Special) Trade* | *In Transit Without Transshipment* | *In Transit With Transshipment* | *Total* |
|---|---|---|---|---|
| Downstream | 5,802 | 7,494 | 15,627 | 28,923 |
| Upstream | 3,001 | 5,829 | 19,215 | 28,045 |
| Both ways | 8,803 | 13,323 | 34,842 | 56,968 |

From: *Jaarcijfers voor Nederland 1938*, p. 302 ('s Gravenhage, 1939).

(In Dutch statistical works, direct imports and exports are often referred to as "special," as distinct from transit.)

The first column shows imports and exports of the Netherlands by way of the Rhine. The second and third columns show the traffic not on Dutch account. The 13,323,000 tons of the second column—"transit without transshipment"—represent three separate categories of goods passing over Dutch waterways. There is a restricted "Rhine-Sea" traffic, inevitably confined to small sea-going ships, passing directly between coastal ports and the lower German Rhine ports (e.g. Duisburg-Ruhrort, Düsseldorf and Köln). In 1938 it amounted to 645,000 tons inward (upstream) and 779,000 tons outward (downstream), mostly cargoes between German ports, although nearly 100,000 tons passed between the Rhine and British ports. The great bulk of the "transit without transshipment" comprises (1) direct (special) trade between the Rhine and France and Belgium, and (2) goods in transit for transshipment at Belgian ports.

Third column in the table—"transit with transshipment"—shows a total of 34,842,000 tons passing between the Rhine and the sea, involving transshipment at Dutch ports. Total of all Rhine cargoes handled by Rotterdam was 31,910,000 tons; the total of all "special" cargoes by waterway handled by Rotterdam was 1,996,000 tons; assuming that two-thirds of this moved along the Rhine, the total of Rhine transit passing through Rotterdam would be about 30,500,000 tons. (Available Dutch statistics give only (a) all waterway traffic at Rotterdam divided into special and transit, (b) all waterway traffic at Lobith, divided by ports, but not (c) the

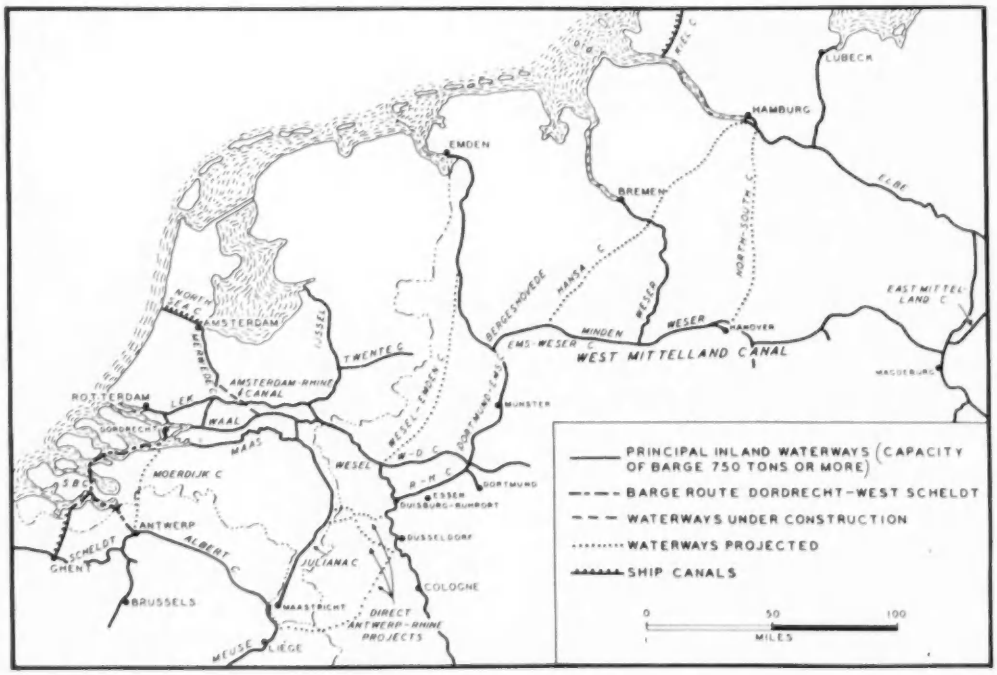


FIGURE 1.—R.-H.C. Rhine-Herne C., S.B.C.—South Beveland C., W.-D.C. Wesel-Datteln (Lippe-Seiten) C. The Juliana C. below Maastricht is connected with the Albert C. below Liege by the Liege-Maastricht C., in which the Ternaeyen (Lanaye) lock will admit only 600-ton barges. Access to the two northern routes at the projected Antwerp-Rhine canals would be given by the Belgium and Dutch Campine canals (not shown on the map).

amount of Rhine transit traffic at Rotterdam.)

## ROTTERDAM

The great Dutch seaport, together with the subsidiary "New Waterway Ports" (Hoek van Holland, Maassluis, Poortershaven, Vlaardingen, Schiedam), forms the natural outlet for the Rhine traffic, having direct access to the two main distributaries of the Rhine—the Lek and the Waal, which provide waterway approaches to the main stream of unequalled convenience. Locks are unnecessary and thus time is saved. (By some engineers a lock is estimated to add the equivalent of 5 km. of distance.) Obstruction by winter ice or by shallowness from summer drought are seldom sufficient seriously to interfere with traffic. In normal times barges up to 2,000 tons carrying capacity could navigate the Lek, while the Waal was used by craft carrying up to 4,000 tons; thence on the undivided Rhine a capacity of 3,500 tons could be carried as far as Köln. Most of the traffic, however, was conducted in 1,000- or 1,350-ton craft. Trains of four or five barges carrying 6–7,000 tons were commonly used as far as Duisburg-Ruhrort, a figure often exceeded. Trains of 2,000 tons were taken as far as Strasbourg, and trains up to 1,500 tons sometimes passed as far as Basel.

Downstream, the New Waterway (opened 1872) leads to the North Sea, and provides low-water depth of 33 ft., passage usually taking no more than two hours. In the port itself, progressive completion of a series of large basins, including the Waalhaven (1913–30), has provided facilities adequate for growth of traffic. Improvements projected in 1939 included measures for prevention of any possible congestion of barges. Perhaps the greatest single natural advantage enjoyed by Rotterdam, after its position at the Rhine mouths, is restricted influence of the tide upon the level of water within the port (5½ ft. rise M.H.W.N.), which obviates need of wet docks for cargo handling, so that barges can move to and from moored ships without spending time in the passage of locks. At Antwerp, Rhine barges pass through locks from the Scheldt into the wet dock system.

The combined total for transit traffic and special trade for the Netherlands made Rotterdam and its subsidiaries the largest port in Europe, exceeded in the world only by New York.

TABLE III

SEA-BORNE TRADE (FOREIGN AND COASTWISE) 1938

(In thousands of tons)

| | *Imports* | *Exports* | *Total* |
|---|---|---|---|
| Rotterdam, including the other New Waterway ports | 27,504 | 19,261 | 46,765 |
| Rotterdam only | 24,504 | 17,867 | 42,371 |
| London | 34,538 | 7,540 | 42,078 |
| Hamburg | 18,241 | 7,501 | 25,742 |
| Antwerp | 11,873 | 11,706 | 23,579 |
| New York (total) | 43,920 | 13,702 | 57,622 |
| New York foreign | 12,303 | 7,143 | 19,446 |
| New York coastwise | 31,591 | 6,548 | 38,139 |

From: *Rotterdam Statistiek van Handel, Nijverheid en Verkeer 1929*, I, p. 56 (Rotterdam n.d.); *Statistical Abstract of the United States*, 1941, p. 494 (Washington, 1942).

Transit trade at Rotterdam, forming over three-quarters of the total, exceeded in weight the entire trade of Hamburg or Antwerp, and transit trade in coal and ores alone almost equalled the entire trade of each of the two ports. So great dependence upon so few commodities is most unusual for a "world port."

The waterway trade in transit alone (leaving aside the "special" and domestic traffic) is larger than in any other seaport in the world. Rail movements are unimportant.

At Hamburg in 1937 rail-borne transit amounted to just over one million tons

TABLE IV

TRANSIT AND SPECIAL TRADE OF ROTTERDAM (EXCLUDING OTHER NEW WATERWAY PORTS), 1938

(In thousands of tons)

| | *Arrival by Sea* | *Dispatch by Waterway* | | *Dispatch by Sea* | *Arrival by Waterway* |
|---|---|---|---|---|---|
| Special trade | 7,004 | ..... | Special trade | 3,018 | ..... |
| Transit trade: Coal, coke, etc. | 488 | 491 | Coal, coke, etc. | 11,128 | 10,875 |
| Ores | 10,911 | 10,879 | Metals | 168 | 154 |
| Iron and steel | 450 | 442 | Iron and steel | 288 | 282 |
| Mineral oil | 525 | 503 | Minerals | 921 | 921 |
| Timber | 647 | 638 | Nitrate of soda | 538 | 533 |
| Oilseeds | 759 | 735 | Natural stone | 333 | 333 |
| Cereals | 1,948 | 1,772 | | | |
| All transit | 17,500 | 16,827 | All transit | 14,849 | 13,839 |

From: *Rotterdam Statistiek, etc.*, 1939, pp. 36–43, 59–65 (Rotterdam, n.d.).

and water-borne transit to 857,000 tons.

The hinterland of Rotterdam includes Switzerland and eastern France as well as the Rhine valley, the Ruhr-Westphalia industrial regions and the Netherlands; there was a small movement across the Belgian frontier of goods for transshipment in Dutch ports—464,000 tons in 1938, of which doubtless much was handled by Rotterdam. The lower and middle Rhine and the Ruhr provided the bulk of the traffic of the port so that prosperity fluctuated closely in accordance with output of coal, and consumption of ore, in Germany. Of all large ports of western Europe, Rotterdam was most dependent upon factors exterior to the national economy. Two capital problems will govern its future. First and most obvious is the level of economic activity at which the Rhine basin, and above all the Ruhr, eventually stabilises.

TABLE V

TRANSIT TRADE, 1938, BY RAIL AND WATERWAY

(In thousands of tons)

| | *By Rail* | *By Waterway* | *Total* |
|---|---|---|---|
| Rotterdam | 170 | 30,666 | 30,836 |
| Antwerp | 3,283 | 6,450 | 9,733 |

The second problem is of much longer standing. It arises from attempt of various seaports and transport agencies to trespass upon the stream of Rhine traffic and divert part of it through their own installations. In so far as they are successful they become vitally interested themselves in the future level of activity in the Rhine basin. Taken all in all, the second problem is much the less serious one for Rotterdam. Effect of measures taken by the competing outlets, in face of great advantages of location and organisation pos-

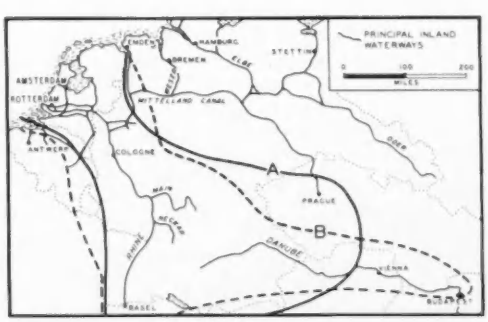


FIGURE 2.—The Hinterland of Rotterdam. "A" represents the boundary of the hinterland of Rotterdam according to Stichling "Havenbelangen" Rotterdam; "B" represents the "trade hinterland of Amsterdam and Rotterdam" after Oxholm, *Lumber Market in the Netherlands*, U. S. Department of Commerce, 1925 (from I. Bowman, *The New World*, Fourth edition, p. 206, [London 1928] Frontiers of 1939).

sessed by Rotterdam, is generally to capture only a small fraction of the total Rhine traffic, and to succeed most in the "marginal" instances. Thus, proportionately more has been lost in the smaller traffics of eastern France (to Antwerp), Switzerland and South Germany (to Hamburg and Bremen aided by special railway rates) than in the enormous Ruhr-Westphalia movement (to Antwerp, Ghent, Amsterdam, Emden and Bremen). It is important to remember also that effect of successful achievements by the rivals is not cumulative. Amsterdam, Antwerp, Ghent and Emden compete with Rotterdam, but to considerable extent they compete for their share with each other.

It may be appropriate at the present juncture to consider the problem of the approaches to the Rhine. Existing approaches are being revived, new ones have been brought into being, and several others have been planned. It will also be interesting to see what place there will be in the new postwar conditions for operation of the Franco-Belgo-Netherlands treaty of 1939, which, in a great measure, was concerned with the possibility of equitably sharing traffic of the river.

## APPROACHES TO THE RHINE

A number of canals and rivers connect the Rhine with various inland waterways in Europe: over the resulting network are transmitted influences which affect price of coal, for example, at places as far apart as Berlin and Lyons. The connecting waterways have assumed ever-increasing importance and their development has become a vital policy in half-a-dozen different countries. Possible completion of other projects would enormously enlarge the influence of the Rhine system. There are at least six such projects in view. One very important work was completed shortly before outbreak of war. At whatever level postwar trade functions in Europe, connecting waterways of the Rhine will play a vital part. In 1937 Dutch barges operated in considerable numbers as far as Magdeburg, Kehl and Regensburg, while "On the morrow of the war hopes are being cherished in circles connected

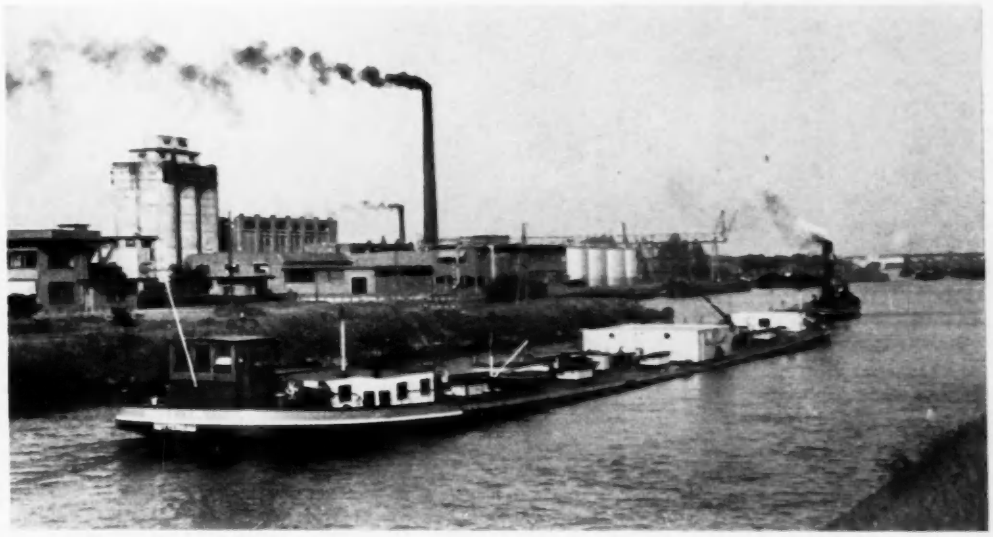

FIGURE 3.—Merwede Canal, Zuilen, Northwest of Utrecht. A vegetable oil refinery and a "Shell" tank barge are in sight. (Courtesy S. H. Beaver.)

with Belgian traffic on inland waterways of extending activities of the Belgian fleet as far as the Black Sea. Less far-reaching plans took it for granted that the fleet would serve Berlin, and even Prague, through the construction of a Rhine-Danube Canal" (M. Zwalf).

Each of the connecting waterways functions as a link in the internal trade of each country, or in foreign trade between neighbouring countries, but a common feature is their value to a number of seaports. Competition between seaports expressed through waterway transport also finds expression in competition between waterways and railway systems and between railway systems. Marginal traffic for which rail and water can compete is much greater in amount and variety than is generally thought. Ramifications of the rail problem, however, are too numerous to be considered here. Connecting approaches, both actual and projected, number fifteen:

1. Amsterdam-Rhine and Merwede Canals.
2. Ijssel.
3. Hollandsch Diep, East and West Scheldt route to Antwerp and Ghent.
4. Moerdijk canals project.
5. Direct Antwerp-Rhine canals project.
6. Dortmund-Ems Canal.
7. Wesel-Emden canal project.
8. Mittelland Canals.
9. South Mittelland canal project.
10. Weser.
11. Hansa canal project.
12. North-South canal project.

FIGURE 4.—Widening of the Merwede Canal. The broken line indicates extent of widening the existing canal, part of the new Amsterdam-Rhine Canal. (Courtesy Gemeente Amsterdam.)

13. Rhine-Main-Danube and Rhine-Neckar-Danube projects.
14. Strasbourg-Basel section of the Upper Rhine.
15. Rhône project.

### AMSTERDAM-RHINE CANAL

Amsterdam enjoyed water connection with the Rhine for several centuries

before the railway age. During the last hundred years it has been regarded as pre-eminently a liner port, but with growth of heavy industry in Germany, Amsterdam sought to secure a share of the bulk traffic, and completion of the Merwede Canal (1892) permitted some measure of success. The canal ran through Utrecht to cross the Lek by locks at Vreeswijk and Vianen, reaching the Waal at Gorinchem. Eventually enlarged to admit barges of 2,000 tons capacity, it allowed Amsterdam to become third largest outlet for the Rhine after Rotterdam and Antwerp, and transit traffic amounted to about one-third of the total passing through the port.

The railway was of negligible importance in the considerable transit traffic. Here, as in other ports, waterway traffic in transit was not confined to bulk traffic—merchandise or general cargo had been increasing.

Of the total of barges, those passing between Amsterdam and Germany included comparatively few in ballast; of those passing to other countries (i.e. France and Switzerland) there was great disproportion in cargo: outgoing Rhine

TABLE VI

SEA-BORNE TRADE OF AMSTERDAM, 1935, 1938

(In thousands of tons)

| | *1935* | | | *1938* | | |
|---|---|---|---|---|---|---|
| | *Total* | *Transit* | *Special* | *Total* | *Transit* | *Special* |
| Inward | 3,184 | 699 | 2,485 | 3,485 | 1,054 | 2,431 |
| Outward | 1,750 | 760 | 990 | 2,169 | 976 | 1,193 |
| Total | 4,934 | 1,459 | 3,475 | 5,654 | 2,030 | 3,624 |

From: *Jaarstatistiek van den In—Uit en Doorvoer*, Vol. I, pp. 380–3 ('s Gravenhage, 1939).

TABLE VII

CARGO PASSING BETWEEN AMSTERDAM AND THE RHINE, 1938

| *Incoming Barges* | | *Outgoing Barges* | |
|---|---|---|---|
| *Cargo* | *No.* | *Cargo* | *No.* |
| Merchandise | 824 | Merchandise | 823 |
| Coal and coke | 604 | Coal and coke | 5 |
| Gravel | 231 | Ores and pyrites | 114 |
| In ballast | 16 | In ballast | 863 |
| Others | 171 | Others | 121 |
| Total | 1,846 | Total | 1,926 |

From: *Verslagen der Bedrijven Diensten en Commissien van Amsterdam over* 1938: *Handelsinrichtingen*, pp. 7–8 (Amsterdam, 1939).

FIGURE 5.—The Amsterdam-Rhine Canal. A section of the new canal between Tiel and Wijk-bij-Duurstede. At the moment the construction is near completion. (Courtesy Gemeente Amsterdam.)

barges to countries other than Germany numbered 753, of which 735 were in ballast.

Importance of the Rhine traffic to Amsterdam was therefore considerable: the Merwede Canal had become inadequate, and in 1937 work was started upon a superior waterway, the Amsterdam-Rhine Canal, diverging southeastwards from the old route near Utrecht, and crossing the Lek at Wijk-bij-Duurstede, to reach the Waal near Tiel. This canal will admit 4,000-ton barges, and will be equipped with lighting installations to permit passage at night; it is thus clearly designed to serve bulk traffic primarily. Work was designed to be completed in 1944, but has been greatly interrupted by the war. Amsterdam will therefore be admirably placed for the Rhine traffic, and will be vitally interested in its future magnitude.

### River Ijssel

The Ijssel is the most northerly of the Rhine distributaries, carrying 11–12 per cent of the Rhine water. It will admit 2,000-ton barges except at low water. The river is of little importance as outlet for Rhine traffic, except for coal which descends the Ijssel as far as Zutphen and then turns eastwards to Twente along the Twente Canal.

### Hollandsch Diep—East and West Scheldt Route to Antwerp and Ghent

Bulk of the traffic of Antwerp is concerned with Belgium, Luxembourg and Eastern France, and depends much upon railway connections. Nevertheless the port is second only to Rotterdam for Rhine traffic. Of 23.6 million tons handled in 1939, 9.4 million tons were in transit. Two-thirds of this substantial quantity moved along waterways—a little passed direct to Dutch destinations and to France via the Belgian canals but most of it moved along Dutch waterways to and from the Rhine. Total traffic with Germany fluctuated around 5–8 million tons, roughly equally divided in either direction; coal dominates downstream movement and ores upstream movement. Remaining traffic passes to Strasbourg and, to lesser extent, Switzerland. Ghent shares in the Rhine traffic in secondary fashion and disputes with Amsterdam third place after Antwerp and Rotterdam. It is well equipped for handling bulk cargoes and specialises in raw cotton imports. In their function as outlets for the Rhine, the two Belgian ports compete most obviously with Rotterdam and Amsterdam. Secondary competition prevails with Emden, Bremen and even Hamburg, however, and in so far

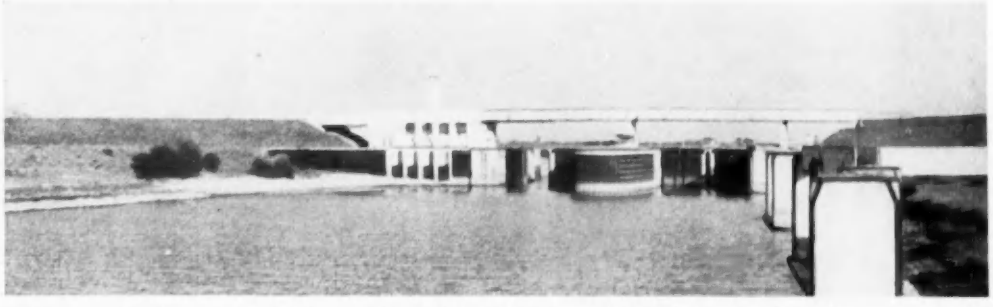

FIGURE 6.—Locks on the Amsterdam-Rhine Canal at Wijk-bij-Duurstede. They permit the canal to cross the river Lek. (Courtesy S. H. Beaver.)

as they are transshipment points for Strasbourg, with several French ports. The existing waterway route between the Rhine and Antwerp lies through the West Scheldt, South Beveland Canal, East Scheldt, Hellegat, Volkerak, Hollandsch Diep, Dortrecht and the Noord. The route suffers from several drawbacks —barge navigation in tidal estuaries is often difficult, canal locks are frequently congested, and the West Scheldt itself carries a heavy traffic of ocean-going ships. Mainly as result of passage of this traffic, the South Beveland Canal carries more traffic than any canal in Europe.

### PROJECTED MOERDIJK CANALS

Maintenance of a share in the Rhine traffic has been a cardinal feature of the policy of the Antwerp and Ghent port authorities. The Belgians have pondered several projects for removing drawbacks of the existing route, of which the most favoured is for a barge canal running from Antwerp itself to Moerdijk on the Hollandsch Diep, taking its course through the Dutch province of Noord Brabant at some little distance inland from the estuaries. Between 1919 and 1927 the matter was the subject of considerable negotiation between the two governments. At one time the Dutch seemed likely to concede the point, but exchanges were complicated by introduction of the West Scheldt and Wielingen issues and by the not unnatural opposition of Rotterdam.

### PROJECTED DIRECT ANTWERP-RHINE CANALS

These projects are rivals to the Moerdijk project but have been the subject of less discussion. Each envisages construction of a canal from eastern Belgium to the Rhine near Duisburg-Ruhrort. Such a route would appear to have one great advantage over that of the projected Moerdijk Canal—from Duisburg to the sea at Antwerp by the direct canal would be no farther than from Duisburg to Rotterdam, but it would be counterbalanced by loss of time involved by passage of locks. The projects date back more than a century, and their history illustrates the evolution of changing attitudes to railway and waterway as means of transport. In the Treaty of 1839, which definitively settled the independence of Belgium, Article 12 gave Belgium the right to build a canal towards the Rhine, for the value of

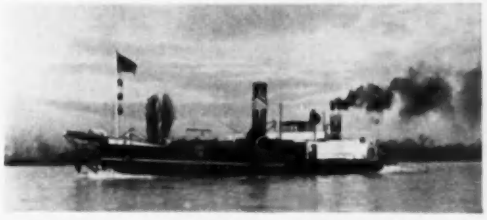

FIGURE 7.—A French Rhine Paddle Tug. Such craft facilitate and expedite river and canal traffic. (Courtesy Port Autonome de Strasbourg.)

Rhine traffic was clearly recognised even then. But very soon it seemed that the railway would replace the waterway for carriage of goods, and this right was renounced in return for the privilege of building a railway to Gladbach, partly across Dutch territory. (The Antwerp-Köln railway, completed in 1843, had been described in Belgium as "another arm of the Rhine.") In the present century, however, attention was again focused upon waterways for bulk transport and in the Treaty of Versailles, the Belgians (Article 316) secured the useful concession of an obligation upon Germany to complete the eastern half of a proposed direct Antwerp-Rhine canal if Belgium constructed the western half. There were two possible routes for such a canal. One passed from the Zuid-

Willemsvaart via the Noorder Canal through Dutch Brabant to Grimlingshausen near Düsseldorf, crossing the Maas at Venlo; the other involved use of the Maas as far as Venlo, whence a canal would branch eastwards to Duisburg. (The latter route would not have provided a direct route to Antwerp until the Albert Canal had been completed.) The drawback to both routes was that they involved passage of Dutch territory, and Dutch assent to the proposals was not forthcoming; interest therefore turned more to the Moerdijk project. A further plan was considered, one having advantage of avoiding Dutch territory, for a canal from the Meuse below Liège, to Grimlingshausen on the Rhine via Aachen. The route, however, passes over ground of some altitude, and construction of the canal would have involved a very great capital outlay.

### FRANCO-BELGO-NETHERLANDS PORT AGREEMENT

The problem of competition for Rhine traffic between Rotterdam, Amsterdam, Antwerp and Ghent entered upon a new phase in 1939, indicative of the tendency for a more coöperative approach to common problems by the Belgian and Netherlands governments. For some years the Belgian government had given bounties in order to attract river traffic to Antwerp, and the Dutch had retaliated in one way or another. The French government, too, had been interested in the matter: the Dunkirk Chamber of Commerce demanded protection from the competition of Antwerp, and to considerable extent the French government could only grant it by making compensatory concessions to Antwerp, such concessions being largely made possible by diverting from Rotterdam to Antwerp an increasing share of French traffic passing between the Rhine and the sea, e.g. potash.

Discussions between the three governments led in 1939 to conclusion of the highly interesting "Agreement regarding certain Questions connected with the Régime applicable to Navigation on the Rhine." Principal articles of the agreement (1) gave the Netherlands equality of treatment with Belgium concerning goods which enter or leave Strasbourg by the Rhine (a position to be reached progressively in a 5-year period); (2) ended increase by Belgium of bounties for Rhine traffic using Antwerp; (3) apportioned the share of the Belgian ports in the Rhine traffic at not less than 18 per cent or more than 24 per cent. A further article envisaged examination of the possibility of fixing by common agreement, taxes and dues chargeable at the ports of Antwerp, Ghent, Rotterdam and Amsterdam. The agreement continues to be in force (1946).

In 1938, of all Rhine traffic at the Dutch frontier, 15.3 per cent passed to or from Antwerp and Ghent, representing 74.03 per cent of all Belgian traffic with the Rhine. If the treaty is implemented it is clear that the tendency for Antwerp to seek improved connections with the Rhine will be considerably modified. The question has been asked whether agreement upon parity of port dues among the four seaports would lead to any possible exploitation of the countries in the hinterland. The prime motive was a desire to avoid cut-throat competition, but such a question is natural among inland traffic users when rival transit ports take any steps towards mutual agreement upon transit charges. The development, however, focuses attention upon other possible outlets for the Rhine traffic, and to them we may now turn.

## DORTMUND-EMS CANAL

Inland waterways of Germany in 1939 offered appreciable competition to the Rhine-Rotterdam route. More competing waterways were under construction or approaching completion, and more were projected. Motives of economic gain, military advantage and national prestige combined to render significant German attempts at diversion of Rhine traffic.

Classic example of the German waterway competitors is the Dortmund-Ems Canal, first proposed in 1882 but not constructed until 1892–9. It provides the shortest water route from the Ruhr to the sea within German territory. Following a generally northerly course from Dortmund, the waterway comprises a true canal as far as Meppen for about half the total distance to the sea (167 miles) running parallel to the river Ems and to the east. From Meppen to Emden the waterway comprises the canalized Ems. Work was in progress at the outbreak of war to extend the canal proper almost as far as Emden. A total descent of 230 ft. is overcome by a ship-lift at Henrichenburg and by 19 locks. Built to take vessels of 600 tons capacity, the canal will admit partially loaded 1,000 ton barges. Extensive enlargement works have been carried out, and in 1939 further works were in progress to permit passage of 1,500-ton vessels.

For six years the waterway served directly only the eastern part of the Ruhr, but completion of the Rhine-Herne Canal in 1905 connected it with the greater part of the industrial area and with the Rhine at Duisburg-Ruhrort. The Dortmund-Ems waterway was designed to divert from Rotterdam to Emden as much as possible of the Ruhr traffic, but its success was comparatively modest, partly because facilities at the Dutch port were far superior to those at Emden. Through traffic on the waterway amounted to 4 million tons in 1913, nearly 9 million tons in 1928, and about 6 million tons in 1937, 1938 and 1939. In the last year before the war there was some diversion from the canal of Ruhr coal destined for Berlin: considerable quantities which had formerly passed along the entire waterway to Emden, thence to Hamburg by sea, and thence to Berlin by barge along the Elbe, now left the Dortmund-Ems waterway at Bergeshövede to reach Berlin by way of the Mittelland Canal (completed in 1938). This, and other traffic passing between the Ruhr and Central Germany, accounted for the fact that the canal (southern) section of the Dortmund-Ems waterway carried about 11 million tons, or nearly twice the tonnage passing

TABLE VIII

COAL AND ORE TRAFFIC AT EMDEN, 1937

(In thousands of tons)

| | *By Land* | | *By Sea* | |
|---|---|---|---|---|
| Coal, coke | To Emden by barge | 2,531 | From Emden, coastwise export | 2,257 |
| | To Emden by rail | 1,975 | From Emden, foreign export | 1,582 |
| | Total | 4,506 | Total | 3,839 |
| Ores | From Emden by barge | 2,552 | To Emden, foreign import | 3,715 |
| | From Emden by rail | 1,017 | | |
| | Total | 3,569 | Total | 3,715 |

From: *Die Guterbewegung auf deutschen Eisenbahnen*, 1937 Heft I, pp. 31, 35; Heft II, pp. 34, 37 (Berlin, 1939) *Die Binnenschiffahrt im Jahre*, 1937, pp. 6-7 (Berlin, 1938), *Die Seeschiffahrt im Jahre*, pp. 18–27 (Berlin, 1939).

along the whole length of the waterway.

Emden, at the seaward end of the waterway, functioned mainly as transit point for the Ruhr.

Total barge traffic at Emden in 1937 was 5,622,000 tons, of which coal and coke moving to the port and ores moving from the port amounted to 5,083,000 tons. It is a reflection of the ability of the railway to compete with the waterway that in the same year 2,715,000 tons of coal, coke and ores were handled by rail at the port.

### PROJECTED WESEL-EMDEN CANAL

For many years possibility of further development of waterways has been a constant pre-occupation of German engineers, economists and geographers. Many new routes have been projected, some perhaps to remain but dreams. One, however, is of interest as an attempt to provide an all-German outlet from the Rhine which would improve upon the Dortmund-Emden route. It is the project for a Wesel-Emden canal, which would take off from Wesel on the Rhine, at the point where it is joined by the Wesel-Datteln or Lippe-Seiten Canal, a waterway parallel to the Rhine-Herne Canal and serving the northern part of the Ruhr coalfield, where newer mining developments have taken place. Improvement works which were being undertaken on the Dortmund-Ems may imply that there is little practical interest in a Wesel-Emden canal. Nevertheless, the proposed route to Emden would be shorter for the western Ruhr, and a new undertaking would enjoy advantages of having been constructed for large craft from the start.

### MITTELLAND CANALS

At first sight the Mittelland Canals would not appear to affect the fortunes of Rotterdam. The system comprises three main waterways connecting the Ruhr canals with the Elbe and Berlin (and thus, through the Hohenzollern and Oder-Spree Canals, with the Oder). In 1915 the Ems-Weser Canal (or West Mittelland), from Bergeshövede on the Dortmund-Ems Canal to Minden on the Weser, was completed, and shortly afterwards, as the Weser-Elbe Canal, was prolonged eastward first to Hanover, then to Peine (1928) and finally to the Elbe at Rothensee near Magdeburg, where the junction was effected by a ship-lift (1938). From the Elbe, the Mark waterways (Ihle and Plauer Canals, Plauer Lake and river Havel) had already been progressively improved for many years. Thus a through waterway for 1,000-ton barges connected Berlin, the Elbe, Brunswick, Hanover and the Dortmund-Ems Canal; and only completion of improvements on the upper Dortmund-Ems Canal was wanted to provide connection to the Rhine for big barges, via the Rhine-Herne Canal (1,350 tons).

In 1937 the Mittelland Canal between Bergeshövede and Rothensee carried 7.9 million tons of goods. Since connection with the Elbe at Rothensee was not opened until the following year, none of the traffic was through traffic, i.e. it comprised only goods moving between places on the canal, such as Minden, Hanover, Brunswick and Peine, or moving between the Ruhr and these places. War intervened before it was possible to assess the place of the Mittelland Canal in long-distance communication. It was designed to serve internal German traffic, and would undoubtedly always serve that traffic mainly. But, assuming no manipulation of rates, it is theoretically possible for the canal to prolong eastward the hinterland of Rotterdam and Amsterdam, and to allow them to compete more effectively with Bremen, Hamburg

and even Stettin. Dutch barges had long operated on most German waterways. In other words, the Mittelland Canal could become a tributary of the Rhine, and open direct water route from Rotterdam toward the central industrial region of Germany, Berlin and Czecho-Slovakia.

The possibility lay behind much of the persistent opposition to the Mittelland Canal project, for many east German grain producers feared competition of cheap imports via Rotterdam which such a canal would permit. For the short time before 1939 that the canal was open for through traffic the problem of conflicting interests in Germany was overcome by institution of a bar of higher rates for through traffic. For the future the issue will turn largely upon the nature and powers of authorities responsible for rate-fixing on the waterway.

### South Mittelland Canal Project

A further suggestion advanced in Germany touches upon possibility of German waterways becoming tributaries of the Rhine. The South Mittelland Canal proposal would link Frankfurt-am-Main with Halle and Leipzig and eventually with Breslau and the Oder. If ever constructed, this canal would act even more as another tributary of the Rhine, for in relation to points over much of its course, Hamburg would enjoy little or no advantage in distance on the map over Rotterdam to counterbalance the Dutch port's direct water connection. More important than either of the two projects, however, is the proposal for a Hansa Canal.

### Bremen, the Weser, the Rhine and the Projected Hansa Canal

Bremen has always been predominantly a railway port, largely because the Weser suffers from certain drawbacks as a waterway, and leads southward into a region of Germany which creates no significant quantity of heavy traffic.

TABLE IX

RAIL AND WATERWAY TRAFFIC AT BREMEN AND HAMBURG

(In thousands of tons)

| | *Rail—1937* | | | *Waterway—1937* | | |
|---|---|---|---|---|---|---|
| | *Inwards* | *Outwards* | *Total* | *Inwards* | *Outwards* | *Total* |
| Bremen | 7,644 | 1,844 | 9,488 | 2,139 | 501 | 2,640 |
| Hamburg | 7,718 | 3,988 | 11,706 | 4,590 | 5,400 | 9,990 |
| | | | | *Waterway—1938* | | |
| Bremen | ..... | ..... | ..... | 2,328 | 836 | 3,164 |
| Hamburg | ..... | ..... | ..... | 3,819 | 6,043 | 9,862 |

From: *Die Binnenschaffahrt im Jahre*, 1937, pp. 6–7 (Berlin, 1938); *Die Güterbewegung auf deutschen Eisenbahnen*, 1937, Heft I, pp. 29, 35; Heft II, pp. 31–7 (Berlin, 1939); *Wirtschaft und Statistik*, 1939, p. 141, 19 Jahrgang.

Rail movements at Bremen were not much inferior to those at Hamburg. They comprised, to great extent, coal and steel moving from the Ruhr, and to much smaller extent, from the Saar. Bremen receives by rail from the Ruhr considerably more coal and steel than Hamburg, but rather smaller quantities of iron and steel goods and machinery (articles which are less sensitive to slight differences of freight cost). The chief items entering Bremen by

waterway are coal, earth and sand, and potash. Waterway traffic at Bremen and at other lower Weser ports increased from 1937 to 1938 more than at most German waterway ports—from 3,693,000 tons (both ways) to 4,799,000. In the latter year, 888,000 tons of coal moved to the lower Weser ports, a figure which shows the value of the Ems-Weser Canal. Construction of this canal amounted to construction of a first-class waterway over half the distance between the port and the Ruhr coalfield, and an obvious second step was taken—the commencement of work upon improvement of the Weser southwards as far as Minden, where a lock provides connection with the canal, which here crosses the river by an aqueduct. The work was in progress in 1939.

With its completion and with resumption of anything approaching normal trade, Minden could become one of the most important waterway junctions in Germany. Bremen would compete for bulk traffic of the Ruhr and Rhine to some extent with Rotterdam (and Amsterdam and Antwerp, but more so with Emden), and with Hamburg for traffic of central Germany and even further afield. Construction of the Hansa Canal (see below) would give Bremen more direct route to the Ruhr, and permit the port to enjoy an advantage over Hamburg, but not so great an advantage as it now possesses.

### HAMBURG AND THE PROJECTED HANSA CANAL

The waterway hinterland of Hamburg comprised the entire Elbe basin and, to a great extent, the upper and middle Oder basin. Completion of the Mittelland Canal should enable it to compete with Bremen for traffic of the region between Magdeburg and Hanover, but while the canal gives it roundabout connection with the Ruhr, comparative advantage in distance is very much in favour of Bremen.

Connection with the Ruhr and Rhine by a direct canal for barges of large capacity was the object of the projected Hansa Canal. Running in a southwesterly direction from the Elbe near Hamburg, the canal would cross the Weser just above Bremen and reach the Mittelland Canal near its junction with the Dortmund-Ems Canal. Such a waterway would, of course, provide for Bremen connection with the Rhine which would be shorter than the route via Minden, but the saving would not be very great. Hamburg would become a formidable entrant for the Rhine traffic. Approximate distances from Duisburg-Ruhrort to the seaports would be as follows:

| | | | |
|---|---|---|---|
| Amsterdam | 120 miles | Emden | 160 miles |
| Rotterdam | 130 miles | Bremen (via Hansa Canal) | 200 miles |
| Antwerp | 200 miles | Hamburg (via Hansa Canal) | 250 miles |

Rotterdam would still enjoy advantages of a waterway without locks, and of the ability to receive the very largest barges. Hamburg would be fairly well placed for some imports of the Ruhr: relative saving of distance for Swedish ores would probably mean a lower freight rate to Hamburg than to Rotterdam; the very small saving in distance by sea for North African ores to Rotterdam would probably not mean a lower rate to the Dutch port. On the other hand, the experience of Emden shows that the new route is not always decisively the more attractive.

In the immediate postwar period, Hamburg finds itself completely sundered from its hinterland by existence of a line of demarcation between the Russian and the British and American zones of occupation. Had the Hansa Canal been constructed before 1939, Hamburg could probably have expected

a more immediate and more substantial revival.

### PROJECTED NORTH-SOUTH CANAL

Further proposal for deflecting traffic from the Mittelland Canal, and thus from the Rhine, towards Hamburg, is the North-South canal. Running from Hamburg southward across the Lüneburg Heath to the canal at Hanover or Brunswick, the waterway would provide the port with a "right-angle" connection with the Ruhr, of considerably greater length than the connection enjoyed by Bremen through the Weser.

### RHINE-MAIN-DANUBE AND RHINE-NECKAR-DANUBE PROJECTS

German plans for connecting the Rhine and the Danube have a long history. The existing Ludwig's Canal is quite inadequate and in 1937 carried only 53,000 tons of goods. Passage across the watersheds of the Franconian Jura would mean high construction costs, difficulties in water supply, and great expenditure of time in movement of barges through the many locks necessary. Nevertheless, work had been in progress on construction of the Main-Danube Canal, and was accelerated in 1938; a start had also been made on the Neckar-Danube Canal, in so far as navigation facilities on the Neckar had been improved. Prime motive of the works was creation of waterway connections between industrial regions of northwest Germany and countries of southeastern Europe, in order to reduce dependence of traders upon connections by sea. The motive was not solely economic.

The future of the works is now enigmatic, and—apart from the question of the economic and political future of Germany—is bound up with several complicated factors: (i) problem of financing the enormous capital expenditures, (ii) future political régime of the Danube, (iii) future political and economic position of the Danubian countries, (iv) future levels of ocean freights. If the canals were completed, however, traffic movements on the Rhine would be considerably influenced. On the one hand, the canals would tend to reverse some traffic downstream from the Ruhr to upstream, away from North Sea ports. On the other hand, their construction would have effect of extending the Rhine southeastwards and with it the hinterlands of Rotterdam and Antwerp, which would trespass upon the railway hinterlands of Hamburg, Bremen, Gdynia, Venice and Trieste.

### NETHERLANDS, BELGIUM, AND THE GERMAN WATERWAYS

Problem of the German waterways in relation to Rotterdam and Antwerp has now been brought suddenly before public attention. Both Dutch and Belgian governments have expressed their views upon the terms of the German treaty now being considered, and both have very clear and positive wishes concerning the future of waterway transport in Germany. The Dutch "aim in the main at ensuring that in future their ports and waterways shall not suffer from competition of German water transport. Any German government should . . . be forbidden to take measures that would favour traffic between the Ruhr and the German North Sea ports, such as low rates or subsidies to German rail, road and waterway transport. Setting up of a special body is proposed for the control of Germany's entire transport system. The peace treaty should prohibit Germany from constructing new canals and from deepening or widening any old ones. . . ." (The Economist, 18 January, 1947, p. 100.) The Dutch

clearly wish to have limits imposed upon ability of the German waterway network to deflect traffic from Rotterdam. The Belgians desire to safeguard the interest of Antwerp in traffic to and from the Rhine. They insist upon "free traffic on the Rhine, . . . limitation of the German Rhine fleet. . . . Other demands concern building of the Rhine-Danube canal and maintenance of Belgian rights to build the Rhine-Meuse-Scheldt canal provided by the Versailles treaty" (The Times, January 22, 1947). To both countries the problem of approaches to the Rhine, therefore, is a very real one.

FIGURE 8.—River Port at Strasbourg, Looking North. On the right is the Rhine, in the centre Bassin de l'Industrie, to the left Bassin de Commerce, Petit Rhin, and Bassin des Remparts. (Courtesy Port Autonome de Strasbourg and Cie. Aerienne Francaise.)

### RIFT VALLEY SECTION OF THE RHINE

Value and possibilities of the Rhine above Strasbourg and its connections present two problems which touch upon the question of competition with Rotterdam. The more immediate issues concern approach to the Swiss port of Basel; the more distant concern power of Marseilles to compete with northern ports.

### STRASBOURG-BASEL SECTION OF THE RHINE

The Rhine provides a transport medium of inestimable value to Switzerland, though it is not without imperfections. Problems of the Rift Valley section of the Rhine do not directly affect the issue of competition between seaports. There is competition for what traffic exists already, and in the later prewar period, Antwerp was competing with Rotterdam with increasing success. France and Germany were directly interested through the frequent

need of transshipment at Strasbourg and Kehl.

Attempts have even been made to operate a direct service between Basel and London, but the venture was hardly economic, for a vessel fit to navigate the North Sea carries too deep a draught for the Rhine above Köln, and lightening of cargo is often necessary. A Swiss company successfully operated an all-water service between Basel and London, by employing fast 400–450-ton motor vessels on a nonstop run to Antwerp and transshipping to steamers. Twice or thrice-weekly departures provided over-all service of 6½ days, nearly as fast as rail-sea services and at one-third or one-half of the cost.

The great bulk of traffic with Basel, however, is by canal and Rhine barges. The direct passage to Basel is attended with some difficulty, owing to swiftness of the current and frequent shift of sand and gravel banks. Substantial part of the traffic, therefore, is carried

TABLE X

WATER-BORNE CARGO MOVEMENT TO AND FROM BASEL 1935–8, BY DIRECTION

(Thousands of tons)

| | *Up (to Basel)* | *Down (from Basel)* | *Total* |
|---|---|---|---|
| 1935 | 2,149 | 68 | 2,217 |
| 1936 | 2,180 | 111 | 2,291 |
| 1937 | 2,741 | 219 | 2,960 |
| 1938 | 2,499 | 205 | 2,704 |
| 1939 | 1,962 | 154 | 2,116 |

by the northern section of the Rhône-Rhine Canal in Alsace, which—in its northern section from Strasbourg to Mulhouse—serves as a lateral canal to the Rhine, and is linked with Basel itself by means of the Huningue branch canal, turning eastwards from a point near Mulhouse. The entire canal traverse involves a considerable detour and passage of a large number of locks; it will admit only 300-ton barges (the average load is 230 tons), and thus transshipment from Rhine barges is necessary at Strasbourg.

A large scale work of improvement therefore would greatly facilitate passage of traffic to Basel by reducing time involved and eliminating transshipment charges. The French propose a new lateral canal (Grand Canal d'Alsace) nearer the Rhine, with seven locks below the Kembs barrage, permitting also development of considerable hydro-electric power. The work was, in fact, begun. The Swiss plan, with which German authorities concurred by an accord of 1929, has remained one of concentrating upon improvement of the Rhine itself: as result of improvements effected in the navigable channel of the river, the proportion of river-borne to canal-borne goods has increased considerably since 1934.

TABLE XI

WATER-BORNE CARGO MOVEMENT TO AND FROM BASEL, 1935–8, BY WATERWAY

(Thousands of tons)

| | *Rhine* | *Rhine-Rhône Canal* | *Total* |
|---|---|---|---|
| 1935 | 812 | 1,405 | 2,217 |
| 1936 | 1,319 | 972 | 2,291 |
| 1937 | 1,016 | 1,944 | 2,960 |
| 1938 | 1,814 | 890 | 2,704 |
| 1939 | 1,561 | 555 | 2,116 |

Eventual solution of the problem of providing adequate access to Basel should cheapen freights to Switzerland and increase proportion of Swiss imports travelling by water, at expense of many rail-borne imports, whether from northern ports between Le Havre and Hamburg, or from Marseilles, Genoa, Venice and Trieste.

## STRASBOURG, THE RHINE, THE RHÔNE, AND MARSEILLES

Strasbourg, by virtue of its position on the Rhine, plays a vital part as entry

for the east-central regions of France. Substantial quantities of potash and iron ore pass downstream through Strasbourg, and it distributes over this region petroleum products and coal received by way of the river. (In 1936 Strasbourg imported 1.9 million tons by way of the Rhine and exported 3.2 million tons.) In 1936, for example, the Lyonnais department received 20,000 tons of coal which had entered France by way of the Rhine. It is the aim of the Strasbourg port authorities to develop the trade in bulk goods; in nine departments along the Saône and Rhône, it is thought, river-borne coal can eventually oust sea-borne coal arriving after transshipment at Rouen, Bordeaux and Marseilles. The Lyons district, and even western Switzerland, represent "frontier" regions in the hinterlands of Rouen, Bordeaux, Marseilles and (by way of the Rhine) Antwerp, Rotterdam and Amsterdam. Lyons is nearer Marseilles than the northern ports, but it is largely the physical peculiarities of the Rhône—its swift current, its variations in level, and its rapids, which subject Marseilles to successful competition of the northern ports for the trade of the Saône and middle Rhône valleys. The Marseilles authorities have long desired a main waterway to Lyons or farther, the Rove tunnel having been completed in 1927 as a first instalment. The position in 1939, however, was that projects for development of the Rhône had turned away from the aspect of radical transformation of the waterway in favour of the power aspect, and work had started on construction of a barrage at Genissiat below Lake Geneva. Marseilles would prefer a lateral canal to Lyons, but the enormous capital outlay cannot be borne by the port alone, and Lyons is unwilling to share the burden. A modest programme of piecemeal amelioration has been adopted. The *Compagnie Nationale du Rhône*, formed in 1934, has begun work on regulation and improvement of certain stretches of the river. In short, the Rhône offers a potential threat to the Rhine which may be very considerable, but which is unlikely of realization for a long time.

# GEOGRAPHY OF GRANT COUNTY, WASHINGTON

*Elbert E. Miller*

GRANT COUNTY is located in the central part of eastern Washington, forming part of the area commonly known as the Big Bend Country. Bounded on the north, south, and west by Columbia River, it forms over half the area which is to be included in the Columbia Basin Project, the largest single irrigation plan ever conceived. Grant County is large, almost a hundred miles long and fifty miles wide. Within the area has been one of the sparsest populations of the state, yet few agricultural regions have had greater changes resulting from war conditions. What the future will bring when the Columbia Basin Project has been completed and thousands of farms are developed in the region, it is difficult to conjecture.

Physically, the county is a south-sloping, semi-arid plateau with elevation varying between 1000 and 2000 feet. The county is divided into five parts on the basis of its soils and topography: the Channeled Scablands, the Waterville Plateau, the Quincy Flats, the Folded Ridges, and the Sand Hills. The Channeled Scablands is largest of the five parts occupying the northern and eastern half of the county to the north and east of Soap Lake, Ephrata, and Moses Lake (see map). The scablands are glacial channels left by meltwater of the ice sheet which covered northern United States during the Pleistocene epoch. At that time a lobe of ice pushed down the Okanogan Valley to the north, blocking the Columbia River channel at or near the present junction of the Okanogan and Columbia Rivers. Columbia River and meltwater of the glacier overflowed the banks of the Columbia and crossed the Big Bend area in a northeast to southwest direction and reëntered the channel of the Columbia River at a point near the present city of Pasco. In a strip approximately fifty miles wide parallel to the Columbia River, numerous channels and steep-walled canyons were carved. The interfluves are covered with deep, fertile soil, generally considered to be partially residual and partially loess.

Southwest of the Channeled Scablands is an area where deposition prevailed, and original layers of basalt have been covered with gravel and sand to depths varying from a few inches to two or three thousand feet. The Quincy Flats occupying the area between Ephrata, Moses Lake, Burke, and Quincy, is an area of sandy and gravelly soil, relatively small part of which is now in cultivation.

In the northwestern part of the county (north of Quincy and northwest of Ephrata and Soap Lake) lies the Waterville Plateau. It is a part of the larger Waterville Plateau to the north and, like it, is an area of rolling hills, deep, fertile soil and important wheat producing region of the state. The Waterville Plateau is separated from the Quincy Flats by an escarpment.

South of a line connecting Moses Lake and Burke and extending a short distance to the southeast to Moses Lake is an area of sand, partially dune sand in the form of barchans and elongated dunes, and partially sand hills which have been anchored by the scanty vegetation of sagebrush, wild sunflowers, greasewood, and bunchgrass.

Extending in a strip seventeen to twenty-five miles wide across the southern part of the county are the eastward extensions of two anticlines, the Frenchman Hills and the Saddle Mountains. Near the eastern boundary of the county they are barely higher than the surrounding plain, but toward the west where they are cut by the antecedent Columbia River they form steep cliffs six to eight hundred feet high. Between the two folded ridges, and marked by the line of the Chicago, Milwaukee, St. Paul Railway tracks, is a rather narrow graben, at present occupied by Crab Creek. Along the valley some irrigation is practiced; otherwise, the area is used only for grazing.

## CLIMATE

Grant County has an agreeable climate with dry, rather hot summers and cold winters. Natives prefer the brisk, crisp winters rather than the dreary, dismal fog and rain of the Pacific Coast. In summer, they endure patiently the blistering hot days knowing that the heat is good for the crops; the low relative humidity makes the sensible temperature less, and with setting of the sun the night air is cool and pleasant for rest.

Sherman has shown that the ten-inch isohyet and the 2000-foot contour line closely coincide in the eastern and northern parts of the county; consequently, practically all of the county has less than ten inches of precipitation. Ephrata (elevation 1275 ft.) has a mean annual rainfall of 7.7 inches; Ruff (elevation 1347 ft.) receives 7.7 inches, and Moses Lake (elevation 1050 ft.) 6.7 inches.

At all seasons the prevailing wind is from the west, and storm tracks follow a west-to-east direction. About 70 per cent of the precipitation falls during the three winter months, November, December, and January. The average snowfall of the county is 15 inches, but variations from two to forty inches are common. Except at higher elevations snow does not stay on the ground more than a few days.

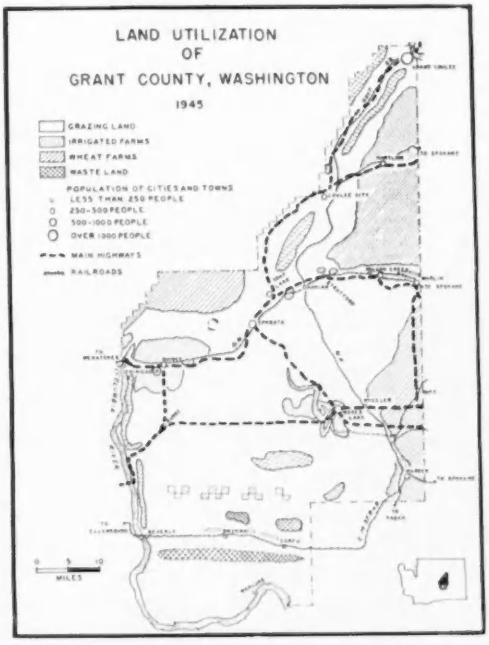


FIGURE 1.—Grant County is located in the central part of eastern Washington, forming a part of the region commonly known as the BIG BEN country. It forms over half the area to be included in the Columbia Basin Project. It is an area of wheat farms and irrigated tracts, separated by large expanses of grazing land.

Hail and high winds sometimes happen in summer, but damage to crops has been negligible because of low frequency of the storms and their small areal extent. Whirlwinds or "dust devils" are a common sight in summer; two or three may sometimes whirl simultaneously within sight on a hot day.

Temperatures are usually moderate, though extremes are occasionally experienced. The twenty-seven-year average at Ephrata is 52° F., with July mean of 76.6° and January mean of 32°. The absolute minimum is −17° F., maximum 112° F. Mean annual tem-

peratures throughout the county are quite similar but the growing season varies considerably with such local conditions as site, altitude, air drainage, and exposure. The average length of the frost-free season at Ruff is 142 days, at Ephrata 181 days, and at Trinidad (elevation 900 ft.) 200 days. Trinidad is located on a terrace about 500 feet above the Columbia River, Ephrata, on a level plain, and Ruff at the bottom of a valley.

cept on the slope between Waterville Plateau and Quincy Flats where the land is too steep for cultivation, all areas having deep soil and sufficient moisture are given over to dryland farming. (Three areas, the scablands in the Channeled Scabland region, the Sand Dune region, and the northeastern part of the Quincy Flats region do not have the deep soil necessary for dryland farming.) Depth of soil necessary for dryland farming varies with moisture

FIGURE 2.—Perspective view of the Columbia Basin Project. Approximate area of Grant County is enclosed within the inked lines. Area to be irrigated is shown in light color.

## FARMING

The leading activity of Grant County is farming, with wheat as major crop. At different times in the history of the county, there were other economic activities such as the mining of gold, China clay, silica (diatomaceous earth), and washing soda which prospered for short periods but which are no longer important.

## DRYLAND FARMING

Farming may be divided into two main types: dryland and irrigated. Ex-

because, other factors being equal, the deeper the soil the longer it holds moisture for growing crops, making the precipitation, which has a winter maximum, available for crop use during the summer months.

In the first decade of the 20th century, half of all farms in the county were between 100 and 174 acres, that being the amount of land one family could cultivate with horses. With perfection of gasoline- and diesel-powered caterpillar-type tractors, dryland farms have increased in size. The 1945 Census

shows the average farm to contain over 1800 acres, half of which is in wheat each year. Other grains are unimportant.

Machinery required to operate a large farm is almost the same as that for a small farm. The average farmer has at least $15,000 invested in machinery, including a truck, tractor, two plows, a harrow sixty to ninety feet wide, two or three drills for seeding, two or three rod weeders, a combine for harvesting, and much other miscellaneous equipment. Recent developments

FIGURE 3.—A worker drinks from his canteen as the wheat from the bin on the combine is unloaded onto the truck. The combine cuts a strip twenty feet wide, averaging forty-five acres a day. It must stop about every half hour to unload. The combine is pulled by a caterpillar-type tractor. It requires one or two men besides the truck and tractor driver to operate.

in handling grain in bulk have reduced costs and labor to the extent that almost all grain is now so handled. Loss due to torn sacks, early fall rains, and wet grain is thereby practically eliminated.

Both winter and spring wheat are grown; many farmers grow some of each with spring wheat occupying the larger acreage. Winter wheat will often yield a few more bushels per acre (this is the opinion expressed by all of the thirty or more farmers with whom I have talked on this subject. The same opinion is expressed in "Regional Geography of Anglo-America," C. Langdon White and Edwin J. Foscue, Prentice-Hall, N. Y., 1945, p. 556. Census figures, however, do not support this belief) and bring a higher price per bushel, but it is subject to heaving, winter killing or winter mold. Spring wheat is not subject to any such danger, but is more likely to suffer from drought because it matures about two weeks later.

The following table shows wheat production and acreage in the county:

TABLE I

WHEAT PRODUCTION

*Spring Wheat*

| *Year* | *Acres* | *Production (1000 bu.)* | *Yield Per Acre Bushels* |
|---|---|---|---|
| 1930*..... | 119,000 | 1,096 | 8.5 |
| 1940..... | 101,000 | 1,571 | 15.5 |
| 1945..... | 130,000 | 2,164 | 16.6 |
| *Winter Wheat* | | | |
| 1930*..... | 3,500 | 21 | 6.0 |
| 1940..... | 16,000 | 239 | 15.0 |
| 1945..... | 18,000 | 278 | 15.4 |
| *Total Winter and Spring Wheat* | | | |
| 1910..... | 180,000 | 1,728 | 9.5 |
| 1920..... | 160,000 | 1,238 | 7.7 |
| 1930..... | 123,000 | 1,036 | 8.4 |
| 1940..... | 117,000 | 1,810 | 15.4 |
| 1945..... | 148,000 | 2,442 | 16.5 |
| Average 1910–1940..... | 145,000 | 1,455 | 10.0 |

*Figures not available for 1910–1920 acreage and production of winter and spring wheat.

The table shows that total acreage declined from 1910 until the depression of 1930–40 when it started rapid climb to output above the thirty-year average. Combination of higher prices, government subsidies and higher yields brought the rapid increase.

The most important reason for increased acreages was higher yields resulting from better methods of farming, increased rainfall for a few years, and new and better varieties of wheat. Examination of the climatic summary shows unpredictable wet and dry periods of several years. With so much marginal land in the county, a slight increase in rainfall makes a proportionately

greater increase in yield, and after a year or two of good crops farmers start plowing and planting even poorer land. Use of modern methods and machinery has done much to increase yields because it leaves part of the straw on the surface, shading the ground and preventing erosion and evaporation.

With increased production and lack of freight cars, grain elevators have been filled to capacity, and in some years could not handle all the crop. Consequently, large piles of bulk grain are seen in many places in early fall. The piles, some of which are 150 feet in diameter and as much as thirty feet high, are usually close to elevators situated on railroad lines. The practice is safe because of rainless summers, and since grain is usually shipped out before fall rains start, losses are slight.

## IRRIGATED FARMING

Since 1920, the amount of land devoted to irrigated crops has varied considerably. At that time fruit was the leading crop, followed by alfalfa. Because cost of spraying and packing fruit was high and market price low, fruit growers were in an unfortunate position when the depression came. Unlike wheat farmers or growers of annual or short-lived plants, they could not quit for a few years and wait for higher prices. A law designed to prevent spread of codling moth required that trees be sprayed. To reduce expenses the trees were usually pulled out. Much land formerly in apple trees has been planted to other crops, but some acreage was abandoned and is still idle. Moses Lake is the only district in which irrigated acreage has increased.

Development of high efficiency pumps, decrease in price of electricity in recent years, use of permanent concrete pipe for carrying and distributing water, government subsidies, high yields from the rich, virgin soil, and recent high prices account for increase in irrigated acreage in the county. Land formerly unsuited for irrigation has now been brought under cultivation, especially in the Moses Lake District where pumping costs now average about $5.00 per acre per season. In the proposed Columbia Basin Project, costs are estimated to be $3.20 per acre for maintenance plus $2.20 to pay initial cost of the project. After forty years the original investment will be amortized and only maintenance costs will be assessed.

Each of the small irrigated areas shown on the Land Utilization Map has its own characteristics, including methods of irrigation, costs of pumping, depth of soil, depth of water table, type of crops, methods and place of marketing and present amount of irrigated land compared to 1920.

Prior to 1930, the Quincy District had about 800 acres of apples and pears but now there is less than 100 acres of orchard with rest of the land in vegetables, or else idle. The deep, fertile, sandy soil warms quickly in spring, enabling crops to mature early. Weeds are not a serious problem in the Quincy District because water is carried directly from private wells to the fields in con-

FIGURE 4.—A modern potato harvesting machine. Besides the tractor driver, about seven men are required to operate this machine which will dig and sack about thirty tons (two to three acres) per day.

crete pipes, thereby eliminating chances of weed seeds floating down the canals, as they do in many irrigation projects. Theoretically, cost of irrigation at Quincy should be considerably reduced because of the deep soil and level land, but because of the depth of the water table (250 feet) costs are still higher than in other areas.

Ephrata, like Quincy, once had a large apple and pear orchard district. Now only two small orchards totaling about 64 acres remain of over 300 acres. Alfalfa, grown by one irrigation, with flood water runoff in the spring of the year, is now the most important crop. Most of it is fed to dairy cattle to supply the town and Army Air Base with fluid milk.

Another irrigated area once devoted to orchards but now idle is Grant Orchards near Soap Lake. Rocky and gravelly soil has made it difficult to change to cultivated crops and deep wells make pumping costs so high that lower income crops are not profitable. When water is available from Grand Coulee at low prices, orchards or vineyards again may occupy a large acreage.

The Moses Lake District is the only former fruit-growing area which has had an appreciable increase in irrigated acreage. Approximately 6,000 acres in 1945 or about ninety per cent of the cultivated acreage was planted in potatoes, the remainder in onions, alfalfa, pasture, soft fruits (apricots, peaches, and cherries), and a few other crops. Grown commercially for many years at Moses Lake, potatoes have only recently become a major crop. High yields obtained through heavy fertilization, good prices in the war years, lower production costs from mechanization, and better farming methods account for the importance of potatoes. Every farm in the district is completely mechanized with row-crop type tractors and special potato-growing machinery. Except for grading and packing very little custom work is done.

Yields as high as twenty-two tons per acre have been obtained in a few instances, but the average is from eight to twelve tons. In the past few years, some growers have been able to pay expenses plus a fifty per cent return on their investment. The profit has been made possible through the application of large quantities of commercial fertilizer, nitrogen and phosphorus.

Two main varieties of potatoes are the White Rose, grown for early market, and the Netted Gem for fall and winter use. A few other varieties are produced but they are not favored by most growers because of smaller yields. In a few cases, a crop of early potatoes and another crop of late potatoes have been grown on the same land in one season, the late crop being planted in mid-July after the early potatoes are harvested. However, there is some danger of frost injury to the late potatoes before they are ready for harvest, and further, the practice is also rather destructive to soil minerals because by the latter part of October when the fall potatoes are harvested, it is too late to plant a cover crop of rye or wheat as is the usual custom.

About half of the growers have large underground cellars, capacity 1,000 to 5,000 tons each, which are used for storage of late potatoes. If the market price is low at digging time (October), potatoes are put into the cellars and kept until January, February, or March, when buyers send grading machines and crews to the cellars to sort the potatoes and ship them by truck directly from the farm to Seattle markets. Potatoes stored in commercial warehouses in Moses Lake or graded and sold at time of harvest are usually shipped by rail to market.

Until recently, there was little truck farming in the district. Since the war started, however, several Japanese families have moved into the area and are growing vegetables. The long dry summer season is especially good for onions and several hundred acres are planted each year. The vegetable industry in the Moses Lake District is handicapped by shortage of labor and lack of market. Work has been so seasonal that few migrant laborers come into the area; farmers must, therefore, plant crops that can be grown with a minimum of additional labor. Furthermore, it is impossible for a grower with a few acres of vegetables to pack and ship them to Seattle or other large cities. Production has been too small to attract buyers and processors from large firms.

## STOCK RAISING

Stock raising, second in importance to farming, is both a separate business and a sideline to farming since many farmers keep a few cattle or sheep, and many sheep and cattlemen do no farming. The animal industry, one of the oldest in the county, developed slowly because of shortage of water but wherever it was available large herds of cattle and sheep were grazed.

In the Channeled Scablands, many farms include some good land as well as some rocky scabland suitable only for grazing. The common practice is to graze cattle on the scabland during the summer, and on stubblefields and winter wheat or rye during the fall and spring. During the winter, cattle are fed hay, grain, and chaff, which usually contains some grain. In other parts of the county cattle are pastured on open range in summer and returned to the farms in the late fall to be fed hay, grain or cull potatoes. Because the range is too dry in summer and other crops offer more return per acre than pasture for dairy cattle, beef cattle are much more important than dairy cattle. Most of the cattle are grade stock with Herefords leading in number because they seem to be better able to fend for themselves.

Cattle raising like other types of farming is becoming more specialized. Although fewer men are raising cattle, the larger herds have greatly increased the total number in the past few years.

FIGURE 5.—A later type of combine—the self-propelled. Only one man is required to operate the combine, but it will harvest only about thirty acres per day.

The herds are fairly well distributed throughout the county, with a total of 20,000 head in 1945. With completion of the Columbia Basin Project, dairy herds will increase in number at expense of beef cattle, as much of the open range now used for grazing will undoubtedly be used for farming.

Sheep grazing, started soon after cattle raising, has increased rather steadily. Grant County now ranks high in wool production, being appreciably exceeded only by Yakima and Whitman Counties. Because of the hot, dry summer, sheep are usually moved to higher pastures in Montana, Idaho, and northeastern Washington. There is excellent early spring pasture in Grant County; the light snowfall is quickly melted, and the grass is soon green. The county is well suited for lambing because cold spring rains are rare and

blizzards are unknown. Consequently, expensive buildings are not needed to protect the lambs and lambing can be done on the open range.

Most of the sheep owners select good wool-type ewes such as Rambouillet, Lincoln, or Romney, and a mutton-type ram such as Hampshire, Shropshire, or Columbia. The resultant cross produces a quick-maturing lamb, and a heavy, good-quality fleece can be clipped from the ewes. An average of nine pounds of wool was shorn from each of the 46,000 sheep in Grant County in 1945. This figure was above the national average. Since 1920, the number of sheep in the county has varied only slightly from its annual average of 40,000.

In the Channeled Scablands, sheep are sometimes kept to eat weeds which grow in the summer-fallowed land of the wheat farms. Under such circumstances, ewes may be of any breed and little attempt is made to raise high quality lambs or fleeces. Farmers believe that if the sheep pay only their costs, they are valuable because they save the expense of weeding the summer fallow.

Relatively few other animals are kept on Grant County farms. The 1940–1945 average of 1,400 hogs was not sufficient to supply local demands. Fowls (other than turkeys) have generally been raised by farm women for pin money and production has not changed greatly during the past twenty years. The total number of chickens in the county in 1945 was 31,500. Turkey production has increased from several hundred to 13,500 in the past seven years as a result of higher prices. The Moses Lake District is most important, with about 9,000 in 1946.

FIGURE 6.—A thriving field of potatoes. Vines are about sixteen inches tall, tubers about two inches in diameter. The field is being irrigated; waste water in the foreground drains away into the lake.

### MARKETS AND TRANSPORTATION

The county is well supplied with rail and highway facilities. Three highways to Spokane leave the eastern part of the county. To the west, state highways extend to Wenatchee, Ellensburg, and western Washington, and to the north, surfaced roads lead to Okanogan and Canada. The county is served by two main transcontinental railways; the Great Northern and the Chicago, Milwaukee, and St. Paul, while a branch line of the Northern Pacific crosses the county from north to south. No inhabited spot in the county is more than twenty miles from a surfaced highway or railroad.

Spokane serves as market for the farmers of the eastern and northern parts of the county; Seattle and Wenat-

chee, for the remainder. Wenatchee and Spokane also serve as distributing centers for implement companies.

## SUMMARY AND CONCLUSIONS

After steadily declining since 1910, rural population in the southern half of the county will certainly increase as the Columbia Basin Project is completed within the next fifty years. It is inconceivable that a large irrigated area will not hold a correspondingly large rural population, since irrigation agriculture is intensive and small to medium-sized farms are the general rule.

Farming will follow the general tendencies of the past few years; dryland farms will become larger and fewer in number while irrigated farms will increase in number but not appreciably in size. (From 1910 to 1945, dryland farms increased in size from 150 to 1,850 acres and at the same time decreased in number from 1,557 to about 400. The total acreage of farm land from 1910 to 1940 remained stationary, averaging about 700,000 acres. By 1945, so much pasture land had been plowed and planted [mostly to wheat] that 1,100,000 acres were in cultivation. This represents an increase of 50 per cent.) In irrigated areas, farming should be more diversified. With a few years of low prices, serious economic disaster will occur in those parts of the county where farmers depend solely upon potatoes for their entire income. (This occurred in 1946 when the government bought over a thousand tons of potatoes, and crushed and dried them to be sold to industrial alcohol factories. The potatoes were bought at the support price of $26.00 per ton and sold at $5.00 per ton making a substantial loss for the government.)

New crops which might succeed are hops, grapes, vegetables, melons, sugar beets, and fruits now grown in the Yakima Valley. All could be produced in the area were it not for shortage of labor and lack of market. With diversification and increased production, such problems will be overcome because produce companies will be able to afford to send buyers into the area and the work will not be so seasonable as is the case in an area specializing in one crop. Dairying should also become important.

In general, Grant County is a dry farming, grazing, and irrigated region ("The Counties of Washington," Belle Reeves, Secretary of State, Olympia, Washington, 1944 Supplement, p. 17. . . . "This county is among the ten leading wool producing counties, and is seventh in wheat production in the state") with declining population until the last decade, but with possibilities of becoming a major farming area of Washington after the completion of the Columbia Basin Project.

# LEEDS AND THE YORKSHIRE WOOLLEN INDUSTRY

*Henry Rees*

MANUFACTURE of wool is one of the oldest industries of Britain. As a home industry it dates back at least to Bronze Age times. But emergence of the West Riding of Yorkshire as the major manufacturing area has been comparatively recent and largely due to existence of supplies of accessible coal in an area of abundant soft water, together with old established skill in the working of wool.

Earliest records of sheep-rearing and wool-working on a large scale in the West Riding area relate to the 13th century monastic houses. Before the age of mechanical power many other areas of England were suited to wool production and the industry was widespread; but only in the West Riding was the environment suited to the textile industry at all its stages. With introduction of machinery in the 1770's the abundant water power could be utilised, and mills were set up in valleys at breaks of slopes of streams, while other centres without water power, such as Norwich and Bristol, slowly declined. Later, with introduction of the steam engine, came decline of regions possessing water power but far from coal. The West Riding industry adapted itself to the new conditions by slight eastward migration, and new mills were erected lower down the valleys, where coal was more accessible; but for the first time the problem of transporting the coal had to be considered, and it was primarily for this reason that the canal system was evolved. So at all times the West Riding has proved a suitable region for wool spinning, weaving, dyeing and finishing, and throughout its history has had the ever-present advantage of soft water from the numerous and regular streams descending from the Millstone Grit moors of the Central Pennines.

We see more clearly special characteristics of the West Riding area if we contrast it with the Manchester region. The two busy districts are separated by only some 10 miles of barren moorland forming the summit of the Central Pennines, yet they have developed distinctly different industries. The cotton district faces west (direction of its chief source of material), the woollen district faces east; one is near the sea, the other far inland. Cotton towns, especially those of the Manchester area, are foothill settlements at points where streams leave the highlands to enter the plain, and they focus on the city of the plain—Manchester. Woollen towns are valley settlements in the heart of the moors, with difficult intercommunication; they have not one "centre" but two.

No other major industrial region has a double capital. Birmingham dominates the Black Country, Newcastle, the N. E. Coast; Manchester is the centre for South Lancashire, Cardiff for South Wales, and Glasgow for Central Scotland. But the West Riding has two foci: Leeds, the regional capital, is the shopping centre not only for the woollen towns but for almost the whole of Yorkshire—a wide area stretching southwards almost to Sheffield, eastwards to Hull and northwards almost to Middlesbrough. Bradford, on the other hand, is a commercial and manufacturing town, chief marketing centre for the woollen and worsted industry.

This is the only important coalfield of Britain lacking direct access to tidewater. The S. Wales valleys lead down to the Bristol Channel; the Northumberland and Durham mining valleys connect with the North Sea, and South Lancashire has long had intimate relations with Liverpool by road, canal and rail. But Leeds is 50 miles as the crow flies from Hull, and about 70 miles of difficult country separate it from Liverpool. Lacking close contact with either of the two chief ports of Northern England, Leeds imports the bulk of its supplies of raw wool from London.

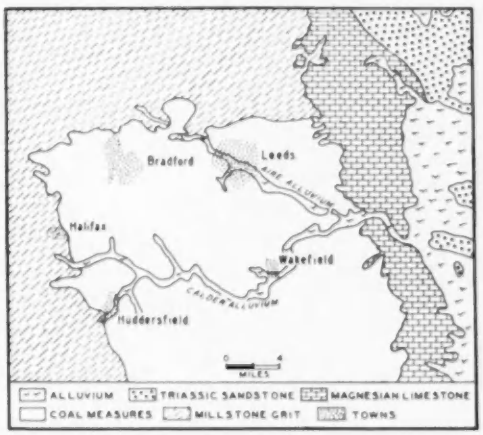


FIGURE 1.—Solid rock geology of the woollen district about Leeds in Yorkshire, indicating the area of the Coal measures of West Riding, the largest coal field in Britain. The woollen towns lie on its most northerly portion.

The coalfield on which the West Riding woollen manufacturing towns are situated—the York, Derby and Nottinghamshire Coalfield—is largest in Britain; it has greatest area of exposed coal measures and greatest known concealed measures. The woollen towns, however, lie only on its most northerly portion. Since the coal measures dip eastwards, the larger and more modern mines have been opened in the eastern concealed coalfield, and the mining industry in the neighbourhood of the woollen towns has for some years been on the decline, though it was an essential stage in development of the textile industry. Cutting eastwards across this portion of the coalfield are the rivers Aire and Calder and their minor tributaries (see figure 1). The headstreams of the Aire rise in an area of Carboniferous limestone to the northwest, and it is a significant comment on the hardness of the water that, apart from Leeds, no large manufacturing town has arisen on its banks. Bradford, however, has grown on the slopes of a southern tributary of the Calder, the Bradford Brook, which rises within the coalfield area, and of which the water is relatively free from lime. It is along the banks of the Calder and its tributaries that the chief wool-working centres have arisen (see figure 2). The stream rises in peaty moors of Millstone Grit of the upper slopes of the Pennines and is also free from lime. Halifax lies in the cul-de-sac valley of the Hebble from the north, and Huddersfield in that of the Colne from the south, while in the Spen valley are a number of smaller settlements, including Cleckheaton, Heckmondwike and Liversedge, of which the specialty is manufacture of carding machines for the woollen industry. The curious specialisation had its origin in the local coal seams and beds of high grade ironstone, now exhausted.

As already mentioned, communications between the towns are difficult, and it is interesting to note various methods adopted at different periods to solve the transport problem. In the 17th century the slow, expensive packhorse was the rule, for roads were indescribably bad and unfit for normal wheeled traffic. Merchants with droves of packhorses purchased their cloth at Leeds and carried it to all parts of the country. Much of it was taken to London, whence it was exported to the Continent and to the American Colonies.

In the 18th Century there was sufficient improvement of the road surfaces to allow use of goods wagons drawn by six or eight horses and lumbering along in well-worn ruts; and we read of daily service between London and Leeds, the journey taking 36 hours. It was in such conditions that the novel idea was conceived of providing water roads or canals along which a single horse, slowly it is true, might draw a load as great as 50 tons.

In 1659 the Aire was made navigable as far as Leeds. What was the obstruction to be overcome? The geological map shows a narrow band of magnesian limestone, some 4 to 5 miles wide, stretching from north to south, which forms a west-facing escarpment, in places reaching 300 ft. above river level. To the east is the flat, low-lying alluvium of the Plain of York, with its slow, winding rivers suited to navigation. But in all cases, before days of river improvement and canal building, the limestone imposed the upstream limit to navigation. Thus arose the river ports of Bawtry on the Idle, Doncaster on the Don, Knottingley on the Aire, and Tadcaster on the Wharfe (figure 2). On them the trains of packhorses converged. In 1659, then, the limestone barrier was overcome and Leeds became the upper limit of navigation on the Aire. Not till another century had passed did canal construction as opposed to river improvement take place. The Calder valley settlements were linked to Leeds and the sea by the Aire and Calder Canal, completed as far as Wakefield in 1760. Later, with building of the Calder and Hebble Canal, Halifax was joined by navigable waterway to Wakefield on the sea. In this way the painful 16-mile journey by packhorse over the moors to Leeds and the Aire Navigation was avoided, and a continuous water route existed from the woollen towns to Hull, and after transshipment, to London and abroad.

Later still came the trans-Pennine canals, the Rochdale-Huddersfield, the Ashton-Huddersfield, and the Leeds-Liverpool canals. The first two never carried very much through traffic, as transport was slowed down by flights of locks by which steep slopes of the Pennines were surmounted. (There are 74 locks in the 20 miles between Ashton and Huddersfield.) But engineers of the Leeds-Liverpool Canal, by using Aire Gap, were able to preserve more level gradient. The work was sanctioned by Parliament in 1769, but was not fully completed till 1816; it involved construction of two aqueducts and a tunnel nearly a mile long. The canal carries very little traffic to-day, and considering the shallow depth at the summit portion (only 4 ft. of water, and less in time of drought) it is difficult to realise how much the canal meant to industrial development of the area at a time when roads were bad and the railway had not yet appeared. Towns along its banks grew rapidly in size and coal of South Lancashire was distributed far and wide.

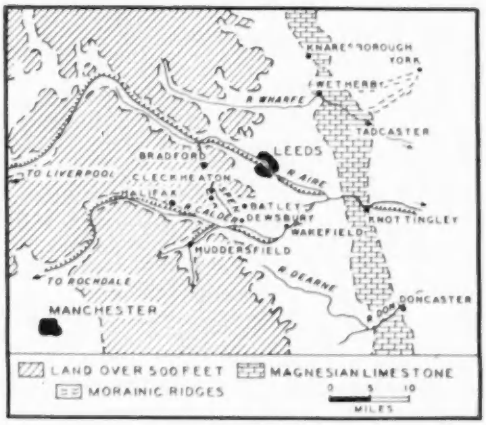


FIGURE 2.—The West Riding woollen district with its chief canals, some physical factors contributing to the growth of Leeds, and the town and neighborhoods mentioned in the text.

Canals served to emphasise the valley system, but with the period of railway building natural obstacles were more easily overcome. Leeds was connected to Selby in 1834, to Bradford in 1846 and two years later, across the Pennines to Manchester. The modern road system pays even less attention to the natural grain of the country. Imagine a regular pentagon: at its points lie Leeds, Bradford, Halifax, Huddersfield and Wakefield. Join the towns one to another by straight lines in as many ways as possible (there are actually ten ways—five sides and five diagonals) and derive an approximation to the road system of the woollen district; an approximation only, because English roads are rarely straight.

A significant contrast with the cotton industry is provided by the way in which specialisation has taken place. It is a well-known, but not easily explained, fact that the northern group of cotton towns, from Preston to Nelson and Colne, specialises in the weaving processes, while the southern group, from Bolton to Ashton, concentrates on spinning. No such specialisation now exists in the woollen industry. There were beginnings of it in earlier times, for weaving machinery was later to arrive than spinning machinery, and when spinning processes were being attracted to water power sites in the valleys, weaving remained in cottage homes of hand loom workers, often on hill top sites. But little remains of the arrangement except that weaving and dyeing processes are sometimes still found on outskirts of towns.

For the most part, however, all processes are combined in the same mill. Specialisation has thus taken place according to type of goods rather than stage of manufacture. Dewsbury and Batley are centres for the rag and shoddy trades, Huddersfield specialises in high quality men's ware, the Colne Valley in fancy woollens. Halifax is home of carpet manufacture in this country, and Leeds is the greatest centre in Britain for manufacture of readymade clothing.

What then are processes with which a typical woollen mill concerns itself? The wool is first sorted into its various qualities, it is "scoured" to extract greases and impurities (a process involving the use of much soft water and soap); it is "carded"—passed between steel toothed rollers in order to open the material fibre from fibre; it is "combed" to separate short and non-uniform fibres and to persuade those remaining to be parallel; it is spun by one of four possible methods; it is "doubled" or twisted with other threads to produce a stronger yarn; it is wound in preparation for the shuttle; and finally, amid the deafening din of the weaving shed, warp and weft are interlaced by the power loom to form a fabric. The bleaching, dyeing and finishing operations are in many places carried out in a separate mill. Again, soft water is a crucial factor, in order that dyes should "take" properly. Many mills are now electrified, with resulting economies. As one general manager put it, "You can switch off an electric motor, but you cannot switch off part of a steam engine."

Let us examine more closely some of the settlements. Bradford (pop. 1931: 298,041), commercial centre of the woollen and worsted industries, spreads in all directions from the valley of Bradford Brook, a small stream which flows northward to join the Aire. A map surveyed in 1802 shows the town little larger than a village, with the church east of the brook, and the "new market place" west of the stream. A canal from the north almost reached the church. Many changes have since taken place. The parish church is now

a cathedral, but it is grimy and all but hidden by the General Post Office and great 5-storey warehouses. The "new market place" has become the city centre, and Bradford Canal is now derelict. Heavy industry has become concentrated in the main valley and smaller tributary valleys which join it from east and west. Following the canal are mills and warehouses, chemical and gas works and an electric power station.

Halifax (pop. 123,766) began as a settlement on the Hebble Brook, which has carved a north to south valley marking the junction of the Millstone Grit series and the Coal Measures (figure 3). Limited by the steep escarpment which overlooks it from the east, the town has spread westwards on to the Millstone Grit moors. Before the canal era the town had established difficult communication northeast to Leeds; but after construction of the Hebble Navigation its interests lay to the south, where its goods could be transported to the Hull district by the Aire and Calder Navigation or the Manchester district over the Pennines by the Rochdale Canal. The waterways are little used to-day, for the railway with aid of frequent tunneling, has linked the town with Bradford and Leeds.

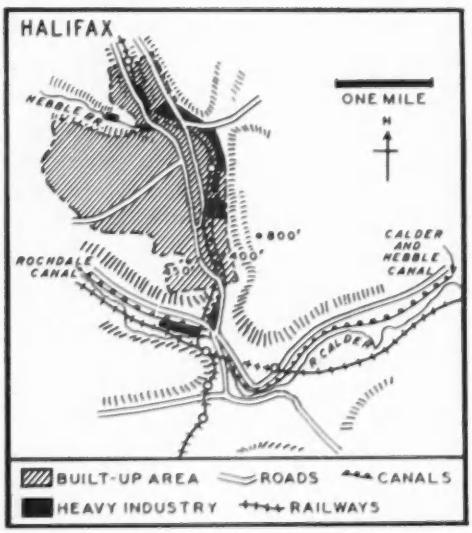


FIGURE 3.—Halifax, and the steep escarpment overlooking the town from the East. The north-south valley of Hebble Brook meets the east-west valley of Calder River to the south. All means of transportation—roads, railways, and canals, crowd into the narrow valleys on the level floors of the streams.

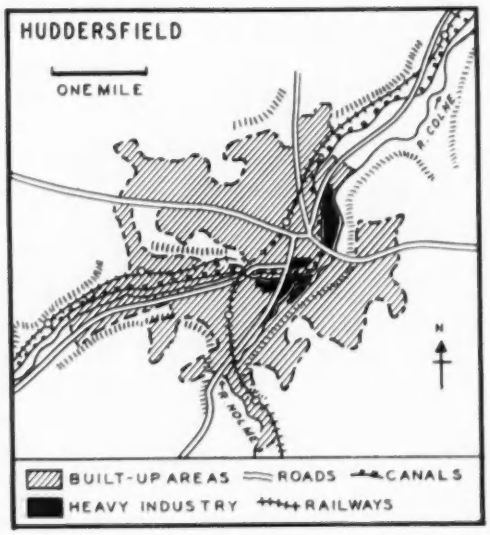


FIGURE 4.—Huddersfield at a stream confluence with an escarpment to the East, similar to that at Halifax, and revealing the same close conformity of means of communication and transportation to the valley floors.

The Halifax trades directory lists 90 firms engaging in various branches of the woollen industry. Only two of them manufacture carpets, yet this is the industry for which Halifax is renowned. The works of J. Crossley & Sons are situated to the north of the town, in the Hebble valley; they include over 30 mills, warehouses and dyeworks, and employ 4–5,000 people. Apart from carpets, the town manufactures a variety of cloth goods, including serges, coatings, fancy worsteds, buntings, blankets and the coarse woollens known as kerseys.

Huddersfield (pop. 113,467) lies at the confluence of a small stream, the Holme, with the Colne, a northward

flowing tributary of the Calder (figure 4). Physically, its situation is similar to that of Halifax, for facing the town from the east is a steep escarpment of the Lower Coal Measures, producing high moorland which is visible even from the centre of the town; and like Halifax, the town climbs the more gentle dip slope to the west. The central area is mainly commercial and residential, and industry is confined almost entirely to the valley floors. Here large scale maps indicate 22 woollen mills, 5 woollen and worsted mills, 7 dyeing, finishing and chemical works, and a number of metal-working plants, including a large motor works, 5 iron works and 2 engineering works. The town lies in an old-established mining area, for the famous Silkstone and Barnsley coal seams outcrop within a few miles, while seams of iron ore were worked as early as the 12th century. For the most part, however, the western portion of the coalfield has been abandoned in favour of areas farther east where coal lay too deep for the 19th century mining engineers.

Leeds (pop. 482,789) is of ancient origin and was mentioned in the Domesday survey of 1085, though at that time it was a purely agricultural centre. By mediaeval times the nucleus of the modern city had appeared—a triangle of streets of which the base followed the north bank of the Aire, extending between the church to the east and the bridge to the west. Beyond the church an eastern limit to the town was provided by the marshy valley of the Sheepscar Beck. The streets with their old names, and St. Peter's Church, survive to-day; but Leeds has spread far beyond the nucleus, and the modern centre has shifted farther west, where the General Post Office and the new station overlook a wide square. A second civic centre was constructed in "The Headrow," which was widened in the 1920's; here are the Old Town Hall, the Reference Library and exhibition hall and the new Civic Hall.

What are physical factors which have favoured the growth here of so large a city as Leeds? The relief map shows that the city stands near the 250 ft. contour. To the east lies the undulating Plain of York with its mixed, though in many places fertile soils producing wheat, sugar beet, carrots, potatoes and pasture. To the west stretch the Pennine moorlands, uplands providing some natural pasture for cattle and sheep, dales producing mainly fodder crops. Leeds, being situated near the junction of the dissimilar regions, has benefited from exchange of commodities between them. But there are other foothill towns of the region. Wetherby (pop. 2,100), Knaresborough (5,900) and Ripon (8,600) are similarly situated but have remained comparatively small market towns.

The unusual growth of Leeds is partly explained by its situation near convergence of three well-marked natural routeways. To the west passes the easiest trans-Pennine route, following the Aire upstream and descending to the valley of the Lancashire Calder, a route emphasised by the Leeds-Liverpool Canal. Continuing it to the east is one of the few dry routes across the Vale of York, following terminal moraines of boulder clay and glacial gravels dating from close of the Quarternary Ice Age. Villages linked by roads cluster along the route. The third passes southwards, carved west of the Magnesian Limestone escarpment by parts of several rivers—lower Calder and Dearne, middle Don, Rother and Erewash—and is followed by important railways to the Midlands. Other more general factors in growth of Leeds must not be forgotten—proximity of soft

water from the Millstone Grit, of water power in the early machine age, and of coal in the later stages of the Industrial Revolution.

We have mentioned that Leeds is the regional capital of nearly the whole of Yorkshire. The city is however a manufacturing centre in its own right. Here much of the reworked wool of the Dewsbury and Batley district is converted into suits. The factories are not confined to any particular zone, but are scattered and surrounded by dwellings, as is customary in textile towns. About 56,000 persons are engaged in the industry, and another 15,000 are employed in the woollen and worsted industries. According to number of employees, engineering is next in importance. It comprises a varied range of products, including much of the machinery needed in woollen, worsted, jute, flax and silk mills; other industrial equipment, such as electrical and hydraulic machinery, printing machinery and agricultural implements; air and seaplane parts, light railway equipment, chain- and anchor-testing machinery, and armour plating machinery. The associated industries employ another 15,000; they tend to concentrate on the level land bordering both sides of the Aire. Other works, such as gas, dye and shoe works and tanneries have gathered in the valley of Sheepscar Beck. The stream for the most part is enclosed through the town. Thus the general rule is followed that lighter industries cling to better drained sites where good labour supply is available, while heavy industries develop on alluvial land, cheap because unsuited to housing; level, and therefore convenient for internal layout and external transport.

Modern Leeds is a city of contrasts. On the one hand are shabby slums where back-to-back houses still remain, wide spaces, apparently due to bomb damage but in reality slum clearance areas, and a noisy antiquated tramway system converging on the City Centre; on the other hand are blocks of comfortable working-class flats at Quarry Hill, the newly planned housing estates, such as that at Middleton, the moorland park at Roundhay, and the shining new civic hall, railway station and University buildings.

This West Yorkshire woollen district has benefited from new methods of transport and improved techniques in manufacture. To-day it retains its unique character, an industrial area set in the midst of rolling moorlands.

# CZECHOSLOVAKIA'S TERRITORIAL AND POPULATION CHANGES

*John Shute*

CZECHOSLOVAKIA today is smaller by about 22 per cent in population and 10 per cent in area than it was in the immediate prewar period. The changes are result of expulsion of the overwhelming part of the country's prewar German population and the ceding of Ruthenia (the Sub-Carpathian Ukraine) to the U.S.S.R., the only significant territorial change for Czechoslovakia as a result of the war. The country has acquired from Hungary a bridgehead in front of Bratislava which is about 30 square miles in area. While these changes were, at least ostensibly, voluntary on the part of Czechoslovakia, nevertheless they pose for that country economic problems unique among those confronting victorious nations. Probable consequences of the changes is worthy of more than superficial consideration in view of the country's position as an area overlapped by Russian and Western influences. Alone amongst the nations within the Soviet orbit, Czechoslovakia is a well-developed industrial state, with a high standard of living, a reasonably well-established tradition of personal liberty, and, most important, a thoroughly Western European cultural orientation. Obviously the economic future of such a nation will have political ramifications unrelated to the limits of its area, population, or industrial potential.

## Loss of Ruthenia

Separation of Ruthenia from Czechoslovakia, like its original inclusion in that state, was a result of political expediency and chance. A part of Hungary for a thousand years, Ruthenia was incorporated into the Czechoslovak Republic largely as a consequence of the Ruthenians in America seeking to select the least objectionable of choices, none of which offered a satisfactory solution. (In 1918 the Ruthenians in the U.S. voted 67 per cent for union with Czechoslovakia, 28 per cent for union with the Ukraine, 2 per cent for an independent nation, and 1 per cent for union with Hungary. Kerner, Robert J. ed. "Czechoslovakia—Twenty Years of Independence," Berkeley, Cal., 1940, p. 203.) Soon after the foundation of the new republic a separatist movement developed which gained momentum in the thirties. The movement was based upon real and fancied failures of the Czechs in fulfilling the terms of the "Resolutions of Scranton" which had specified various conditions attendant upon union of Ruthenia with the Republic. (See: Yuhasz, Michael, "Wilson's Principles in Czechoslovak Practice—The Situation of the Carpatho-Russian People Under the Czech Yoke." Homestead, Pa., 1929; Winch, Michael, "Republic for a Day," London, 1939, also presents interesting background information.) It would appear that, to a large degree, the development was part of a broader movement for establishment of an independent Ukrainian Republic. It is questionable that serious and sincere consideration was given, or indeed, could be given, to the setting up of an independent Ruthenia.

Until the Soviet Union entered the war the position of the Czech Government in exile was easily defined with respect to the future of Ruthenia upon

a victorious conclusion of the conflict. Since Hungary was an enemy nation no objection could be anticipated for the re-incorporation of Ruthenia into Czechoslovakia. However, as an ally of the U.S.S.R., and in view of that country's probable interest in Ruthenia, the Czech position became more difficult. Later, assurances given to President Bênes in August 1942 by the Soviet Government that it would respect the prewar frontiers of Czechoslovakia seemed to have settled the matter.

In January 1945 Petruska, the Ruthenian Communist leader informed President Bênes that a plebiscite had been held in which an "overwhelming" proportion of the Ruthenian people voted for union with the Ukrainian Soviet Republic. Bênes protested to Moscow that this move, which was being propagandized by the Kiev radio, was contrary to the Soviet agreement cited above. The reply given was that the movement was local in origin and would be discouraged. The Czech Prime Minister announced in May that an autonomous government had been established in Ruthenia and that the people wished to join the U.S.S.R. On June 30, 1945 Czechoslovakia ceded Ruthenia to the Soviet Union by a treaty signed in Moscow which stated, in part, that, ". . . on the basis of friendly agreement of both high contracting parties . . ." Ruthenia would, ". . . unite with its long standing motherland, the Ukraine."

## THE LAND AND ITS PEOPLE

Ruthenia is far from being an ethnically homogeneous area. The Treaty of Moscow unites with "its historic motherland" a country, the population of which is 62 per cent Ruthenian-Ukrainian, 16 per cent Magyar, 5 per cent Czechoslovak and 2 per cent German. Since the census classification was based upon "mother tongue" 13 per cent of the population was classified as Jewish. ("Annuaire Statistique de la République Tchécoslovique," Prague 1938, p. 8. Note: The last census for Czechoslovakia was made in 1930. In many instances, such as this, no more recent data are available.) The 1936 population of the area was 798,313 and it was increasing much more rapidly than that of the other provinces. In 1936 the natural rates of population growth per 1,000 were as follows: Bohemia, 0.70; Moravia and Silesia, 3.73; Slovakia, 9.15; Ruthenia, 14.29.

Although the greater part of the population was engaged in agricultural pursuits, Ruthenia could hardly be called an agriculturally efficient region. The country is mountainous and almost half its area is covered by forests. Land utilization is shown in detail in Table I below:

TABLE I

LAND UTILIZATION IN RUTHENIA

(1937)

| *Type of Land* | *Area* | |
|---|---|---|
| | *In Hectares* | *Per Cent of Total* |
| Forests | 588,606 | 46.40 |
| Arable | 238,984 | 18.84 |
| Pasture | 170,997 | 13.48 |
| Meadow | 145,492 | 11.47 |
| Truck Gardens and Vineyards | 11,535 | .91 |
| Water Surface | 10,874 | .85 |
| With Buildings and Unproductive | 59,682 | 4.70 |
| All other | 42,522 | 3.35 |
| Total | 1,268,692 | 100.00 |

Topographical features of the country, its type of land ownership, lack of natural resources, and high incidence of illiteracy, created an occupational pattern sharply divergent from that of the other provinces of Czechoslovakia. About two-thirds of the population was dependent upon agriculture and forestry as compared to one-third for the other provinces. Again, 12 per cent

of the population of Ruthenia were dependent upon industry in contrast to 36 per cent for the remainder of the Republic. A further occupational breakdown is presented in Table II.

TABLE II

PERCENTAGE DISTRIBUTION OF POPULATION BY OCCUPATION (1930)

| | *Ruthenia* | *Balance of Czechoslovakia* |
|---|---|---|
| Agriculture, Forestry and Fishing | 66 | 33 |
| Industry | 12 | 36 |
| Commerce, Banking, etc. | 6 | 7 |
| Transportation | 3 | 6 |
| Public Service and Professions | 4 | 5 |
| Army | 1 | 1 |
| Others without occupation | 8 | 12 |
| Total | 100 | 100 |

Of the agricultural and forestry activities which supported two-thirds of Ruthenia's population it was the lumber industry which was of greater importance. In 1934 the area produced over a million cubic meters of wood or about 11 per cent of the national total. (The efficient maximum potential lumber production for the area was about twice this figure. See Graux, Lucien, "La Tchécosloviquie Economique," Paris, 1930, p. 152.) In terms of certain types of woods used industrially, i.e. not for fuel, its contribution was of greater importance. Thus Ruthenia supplied about 51 per cent of the beech wood which went to Czechoslovakia's chemical industry. Plants for the destructive distillation of wood were the basis of major industrial activity in the region. Ruthenia also provided about 24 per cent of the oak used in the Republic's woodworking industry.

Ruthenia's share in total production of Czechoslovakia's bread grains was unimportant measured in any terms. It was insignificant in absolute terms, smaller per capita than that of the other provinces, and yield per hectare was only about one-third to one-fifth that of Bohemia and generally less than one-half that of the least efficient of the other provinces for each type of grain. The area devoted to production of potatoes was larger than that given

FIGURE 1.—Present European boundaries and relationships. Ruthenia is indicated by the arrow.

over to any single crop and production per hectare was least unfavorable for potatoes, as compared with other provinces. Table III shows the 1937 data for cereals and potatoes.

In addition to its timber, Ruthenia's land produced two other items of significant importance to the country, fruits and tobacco. Of the two crops tobacco was of greater economic importance; in 1936 the region produced 3.4 million kilograms or about 22 per cent of the national total. Most of the tobacco was worked up in factories outside the area with only 7 per cent of the tobacco factory output coming from Ruthenia.

## INDUSTRY IN RUTHENIA

Employment statistics cited earlier are indicative of the absence of industrial development of any consequence

TABLE III

PRODUCTION OF CEREALS AND POTATOES
(1937)

| | *Ruthenia* | *Czechoslovakia without Ruthenia* |
|---|---|---|
| WHEAT | | |
| Area (in hectares) | 31,476 | 821,416 |
| Total Production (in quintals) | 207,956 | 13,744,638 |
| Yield per hectare (in quintals) | 7.1 | 16.7 |
| Production per capita (in quintals) | .26 | .95 |
| Production as Proportion of National Total | 1.49% | 98.51% |
| RYE | | |
| Area (in hectares) | 25,679 | 950,777 |
| Total Production (in quintals) | 137,725 | 14,708,332 |
| Yield per hectare (in quintals) | 6.2 | 15.5 |
| Production per capita (in quintals) | .17 | 1.02 |
| Production as Proportion of National Total | .93% | 99.07% |
| BARLEY | | |
| Area (in hectares) | 3,331 | 668,990 |
| Total Production (in quintals) | 13,957 | 11,136,270 |
| Yield per hectare (in quintals) | 4.8 | 16.7 |
| Production per capita (in quintals) | .02 | .77 |
| Production as Proportion of National Total | .12% | 99.88% |
| OATS | | |
| Area (in hectares) | 30,527 | 748,308 |
| Total Production (in quintals) | 131,240 | 13,592,338 |
| Yield per hectare (in quintals) | 4.5 | 18.2 |
| Production per capita (in quintals) | .16 | .94 |
| Production as Proportion of National Total | .96% | 99.04% |
| POTATOES | | |
| Area (in hectares) | 46,253 | 728,106 |
| Total Production (in quintals) | 3,973,471 | 104,190,601 |
| Yield per hectare (in quintals) | 87.2 | 143.1 |
| Production per capita (in quintals) | 4.90 | 7.23 |
| Production as Proportion of National Total | 3.67% | 96.33% |

in Ruthenia. The condition is further emphasized by the low value of power utilization. In 1930, for Czechoslovakia as a whole, 2,152 horsepower were used per 100 square kilometers of area. For Ruthenia the corresponding figure was 163. Despite its forests the region had no paper industry although this is one of the major industries of the Republic. Leather and textile industries, also of great national importance, had not been established in Ruthenia. Only sawmills and establishments for destructive distillation of wood are worthy of mention as significant industries in the region. Even in such instances however, local importance of the industries was overshadowed by their magnitude in other provinces. Thus, while wood distillation was a great industry for Ruthenia, as measured by employment, the same industry was of equal absolute size in Bohemia.

## MINERAL RESOURCES

Except for its forests, the only other natural resource of Ruthenia is its salt deposits. (Though Ruthenia has potential resources of iron ore, refractory clay, petroleum and natural gas, these are of unknown, but probably insignificant, importance.) The deposits, which were estimated at 60 million tons, supplied almost all of the salt used by Czechoslovakia. In 1936 the mines produced about 173,000 metric tons of salt. In the same year the Republic imported only 4.3 tons of edible salt. It is this fact which is of real significance. Now that Ruthenia is part of the Soviet Union, Czechoslovakia's use of its salt represents a serious drain on the nation's balance of payments with the U.S.S.R. In the latter months of 1946 the Republic was importing Ruthenian salt from the U.S.S.R. at the rate of more

than 40,000 tons a month and in some months the item accounted for at least 28 per cent of the total value of the imports. Czechoslovak Economic Bulletin (published in Prague by the Ministry of Foreign Trade), No. 60, Dec. 5, 1946, p. 4 and No. 63, Jan. 2, 1947, p. 6. It would seem probable that these imports are higher than could be expected for a monthly average and represent the correction of a poor inventory position.) Since Czechoslovakia's balance of trade with the U.S.S.R. is unfavorable, the use of foreign exchange for this purpose must be especially vexatious to the Czechs.

In the conclusion of this article the general economic consequences of the loss of Ruthenia will be restated in the context of Czechoslovakia's population changes.

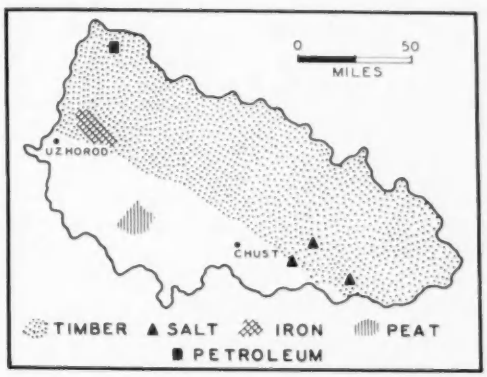


FIGURE 2.—The natural resources of Ruthenia, now lost to Czechoslovakia.

## POPULATION CHANGES

### *Magnitude of Changes*

The population of Czechoslovakia, including Ruthenia, at the close of the war was probably about 15,900,000. (An estimate has been derived from data contained in (a) "Annuaire Statistique," op. cit., 1938; (b) "Vital Economic and Financial Statistics of Czechoslovakia—1938–1945," League of Nations Monthly Statistical Bulletin, Oct. 1945, Vol. XXVI, p. 278; (c) "Statistický Zpravodaj," Feb. 1947, p. 2.) In December, 1946, the population of the Republic was 12,003,000 which represents a decline of about 24 per cent. (About 22 per cent less than the country's prewar population.) In part, reduction has been due to loss of Ruthenia, but of much greater importance has been expulsion of all but a small proportion of Czechoslovakia's prewar German population, borne out in startling fashion by the changes in the density of population. In 1938 the density of population per square kilometer was 114, while in January, 1947, it was only 94.

It is important to recognize that ethnological statistics for Czechoslovakia, as for most Central European countries, are subject to very large probable errors. A significantly large group of Central Europeans are so culturally amorphous and linguistically versatile that determination of "nationality" or ethnic connection could be decided by whimsy in answering a census taker. For such people, desire for identification with the group which carries the greatest prestige value may be the real determinant of classification. The census of 1910, made at a time when the area was part of the Austro-Hungarian Empire, showed the following division among major ethnic groups: Czechoslovaks, 59.5 per cent; Germans, 27.8 per cent; Magyars, 7.9 per cent. In 1921, the first census of the new Republic indicated the following proportions: Czechoslovaks, 65.5 per cent; Germans, 23.4 per cent; Magyars, 5.6 per cent. Finally, the census of 1930 revealed this composition: Czechoslovaks, 66.2 per cent; Germans 22.5 per cent; and Magyars, 4.9 per cent. Neither differential birth rates nor migration can explain successfully such a shift. It would seem safe to assume that the

German population of the country (tenuous though the definition may be) was larger than indicated by the 1930 census, made at a time when the tide of Czech prestige was at its flood.

### *Geographic Distribution of German Population*

Loss of the 22.5 per cent of the population which represented the Germans would, evaluated in any terms, have significant repercussions upon the economy of Czechoslovakia. The effect was amplified, however, because of the peculiar distribution of the Germans, geographically and occupationally. In Slovakia this minority made up only 4.7 per cent of the population, while in Bohemia it represented 37.7 per cent of the total. Even within Bohemia the Germans were quite evenly distributed. Prague and its environs were overwhelmingly Czech, so that for Bohemia, outside Prague, the German population amounted to about 44 per cent of the total. While most of the Germans were concentrated in "Sudetenland" there were solid enclaves of the group throughout Bohemia. Thus it is clear that the problem created by expulsion of the Germans could not be solved merely by substitution of Czechs from the same area. It required wholesale geographic movement of large masses of population.

### *Occupational Distribution of Germans*

As compared to the balance of the population of the Republic the German minority was largely concentrated in industry, commerce, and banking. Approximately 58 per cent of the minority gained its livelihood from this group of occupations in contrast to 38 per cent for the remainder of the population in the same occupations. While about 38 per cent of the non-Germans were engaged in agricultural pursuits, only 23 per cent of the Germans were so employed. Expressed in other terms, the Germans, who composed 22.5 per cent of the population of Czechoslovakia, made up 38 per cent of all those in commerce and banking, 28.6 per cent of those in industry, 14.6 per cent of those in agriculture, and 18.7 per cent of those in public service and the professions. The data are tabulated in Table IV.

TABLE IV

OCCUPATIONAL DISTRIBUTION OF POPULATION
(1930)
By Per Cent

| | *Germans* | | *All Others* | |
|---|---|---|---|---|
| | *Per Cent of Total in Group* | *Per Cent of Total in Occupation* | *Per Cent of Total in Group* | *Per Cent of Total in Occupation* |
| Agriculture, Forestry and Fishing | 23.03 | 14.59 | 37.90 | 85.41 |
| Industry | 45.48 | 28.56 | 31.98 | 71.44 |
| Commerce, Banking, etc. | 12.91 | 38.12 | 5.89 | 61.88 |
| Public Service, Professions, Army | 5.26 | 18.71 | 6.43 | 81.29 |
| All Other | 13.32 | 17.37 | 17.80 | 82.63 |
| Total | 100.00 | | 100.00 | |

Not only did the Germans predominate in industry, but they were especially present in highly skilled branches of industry. Thus about 60 per cent of all employees in the glass industry were Germans and the highly specialized operations within that industry were

carried on almost exclusively by them. In addition to the glass industry, textiles, metalworking, the stone, earth, and ceramics industries were all largely German. It is apparent that the expulsion of the minority over a short period of time required substitution of untrained workers in jobs demanding special skills and training, and, unless successfully achieved, could seriously handicap Czech industrial production for many years.

*Transfer of the German Population*

During the final weeks of the war exodus of Czechoslovakia's German population began with the flight of Nazi party leaders and officials in the occupation government. The petition of the Czechoslovak Government on the German minority question had been made explicit long before the conclusion of the war, and, since the minority was quite well aware of the attitude of the Czech people towards them, the official knowledge that they had to emigrate did not come as a surprise to them. Contrary to widespread belief, the German people were desirous of emigrating, for they knew that at best they would be third rate unwelcome residents amidst an understandably embittered population, and that privileges of autonomous cultural development which they had once enjoyed were lost.

By beginning of 1947 all but about 300,000 of Czechoslovakia's 3,200,000 Germans had been deported to the American and Russian Zones of Germany. Approximately one-half remaining are irreplaceable workers and their families. The other half is made up of partners in mixed marriages, known anti-Fascists and their families, and others. Residence permits have been granted to 25,000 industrial specialists and 17,000 coal miners.

In view of the magnitude of the problem and the far-reaching considerations involved, the transfer was accomplished with amazing rapidity. As of September 1, 1945, Czechs made up only 38.5 per cent of those employed in industry in the predominantly German frontier areas. By March 1946 the proportion had risen to 52.8 per cent, by July it was 59.8 per cent, and on December 1, 1946 had reached 84.7 per cent. Turning from consideration of frontier areas to all of Bohemia and Moravia the position of Germans in industry was changed in an equally spectacular fashion, so that by the end of 1946 the minority made up only 5 per cent of the total workers in manufacturing establishments of the two provinces.

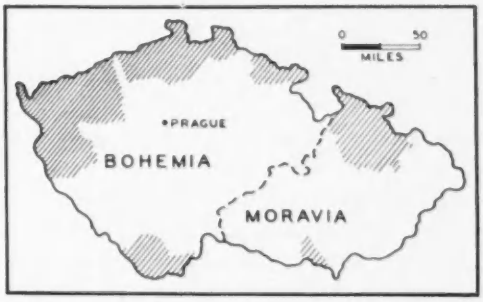


FIGURE 3.—The provinces of Bohemia and Moravia, indicating by cross-hatching the areas from which the greatest number of Germans emigrated (areas with at least 50 per cent prewar German population).

Through expulsion of Germans and confiscation of their land the government acquired 1,650,000 hectares of agricultural land and 950,000 hectares of forests. Approximately 80 per cent of the agricultural land was allocated to some 127,500 new tenants who were settled in the area. The rest of the land was distributed amongst various public bodies, coöperatives, and quasi-public associations, e.g. 25,000 hectares for training camps, 13,000 hectares to water boards, 10,000 hectares to research institutes, 2,000 hectares to agricultural

coöperatives, etc. The population movement involved in resettling this area was so great that it has been estimated that every fourth Czech family had to be moved from the interior to the frontier regions. To a limited extent the areas in Bohemia and Moravia from which Czechs have been moved to replace Germans have, in turn, been filled by Magyars moved from the Hungarian frontier.

### *The Labor Shortage Created by the Expulsion of the Germans*

It is not easy to evaluate from official sources the nature and magnitude of the problem created by expulsion of the Germans. While the policy had the support of all political parties and virtually all the people of Czechoslovakia, nevertheless, the Government, in its efforts to defend the program in every detail, has vacillated between exaggerating the size of the problem in order to enhance its achievements, and, on the other hand, understating its significance to quiet the uneasiness of those who are fearful of particular consequences. A rough evaluation of the far-reaching influence of the mass migration may be derived from data compiled by the Czechs to illustrate effects of the Munich Agreement upon their country. Needless to say, it is clearly recognized that effects of the expulsion could never approximate the loss to Czechoslovakia which followed Munich, but the comparison is valid as evidence of the proportion of the nation's economy which was deeply affected by the removal of the Germans.

The frontier areas from which the migration took place produced 55 per cent of Czechoslovakia's hard coal, 93 per cent of its soft coal, 17.5 per cent of its iron ore, 61 per cent of its textiles, 76 per cent of its glass, 26 per cent of its sugar, 38.5 per cent of its chemicals, 45 per cent of its stone and clay products, 55 per cent of its paper, 30 per cent of its metal and electrical goods, etc. etc. After consideration of such data it is understandable that the labor shortage created by forced migration of the Germans is the primary problem vexing Czechoslovakia today. Prime Minister Gottwald has stated that it is this problem which most seriously will test the achievement of the country's two-year plan, ". . . since, following the transfer of the Germans, there will be a shortage of labor in industry of one-half million."

The Prime Minister's remark undoubtedly represents an understatement. Unless Czechoslovakia is to be content with a much lower industrial production than prewar, the labor shortage will be greater than one-half million. In addition to the general problem of securing a numerically adequate labor force, the secondary difficulty is that German labor cannot be replaced effectively on the basis of a one-for-one substitution of Czech labor. While the Czechs have demonstrated that they are an adaptable and versatile people, nevertheless specialized skills cannot be acquired quickly. As a result of the situation in many Czechoslovak industries employment is far above prewar levels with output lagging significantly below such levels. Average production per head in the hard coal mines is about 60–65 per cent of 1937 production and about 78 per cent in the soft coal mines. Again, at the end of 1946, textile production was about 50 per cent of prewar while, at the same time, employment in the industry was approximately 63 per cent of the prewar figure. After due consideration of decline in the relative efficiency of labor because of lack of maintenance of capital equipment, "war weariness," etc., a gap remains which represents, at

least for the present, a loss of skills. Czech sources tend to overemphasize the two influences. The facts are that the country suffered relatively little physical destruction, that its dietary level is about at its prewar standard, and that, in general, the ratio of capital used per worker is higher than prewar. It is recognized, of course, that for a particular industry the normal relationship between output and employment need not be of a "straight line" character.

*Attempts to Remedy Labor Shortage*

Czechoslovakia is trying many devices to solve its labor shortage. For the most part such devices make up in thoroughness what they lack in ingenuity. Some measures are directed at increasing the labor supply numerically. Thus, an attempt has been made to encourage Czechs living abroad to return to the mother country. In October 1946 it was reported that 5,000 Czech families had returned. Most of these came from Ruthenia, Yugoslavia, Austria, and Poland. The single nation which could make a significant contribution in this matter is Hungary, which has a very sizable Slovak minority. Slovakia, on the other hand, has a significant Magyar population. Exchange of these minorities may, at some future date, serve to reduce Czechoslovakia's population even further. On February 27, 1946 an agreement was reached between the two countries with respect to exchange of populations. According to Czech sources 100,000 Slovaks in Hungary have registered for repatriation. The Deputy Foreign Minister of Czechoslovakia has stated that his country wishes to transfer some 300,000 Magyars to Hungary. Since the great part of Czechoslovakia's Hungarian minority are farmers the transfer should not aggravate consequences of the expulsion of the Germans. The problem is so entangled in deep-seated nationalistic bitterness that the present-day situation and its most reasonable solution are difficult. To date there has been no migration of consequence from Hungary; however, plans have been announced for importation of seasonal labor from Yugoslavia and Italy.

Up to the present, the most promising results have been attained through increasing the proportion of Czechoslovakia's population gainfully employed. It has been accomplished through labor laws which make work mandatory for all except those specifically exempted, e.g., housewives with children, students, etc. Effectiveness of the measure is shown by the fact that, while in December, 1937, industrial employment in Bohemia and Moravia amounted to 10.9 per cent of the population, in December, 1946 it had been raised to 12.3 per cent and was only 47,000 below the 1937 figure in its absolute value. ("Statistický Zpravodaj," February, 1947. (Published by the State Statistical Office in Prague.) Note: Bohemia and Moravia account for about 86 per cent of industrial employment for the entire nation. Satisfactory statistics are generally lacking for Slovakia.) More efficient utilization of the existing labor force is expected to increase effective labor supply somewhat. To this end proportion of piece-rate work is being increased. Efforts are under way to reduce ratio of white-collar workers to other employees. Attendant upon nationalization of Czech industry the proportion of white-collar workers increased at an alarming rate.

As a part of Czechoslovakia's two-year plan it is expected that capital investment in industry will be sharply increased. This, together with the larger area of land now available per agricultural worker, should have a

future beneficial effect on the productivity of labor.

Needless to say loss of Ruthenia has aggravated the labor shortage. The historical propensity of the Ruthenians to migrate would have made of the region a valuable pool of labor. From the long run point of view the very high birth rate of Ruthenia, were it now a part of Czechoslovakia, would do much towards restoring the country's population. Ruthenia's birth rate of 33.29 per thousand was approximately twice that of the country as a whole. For Bohemia the natural rate of population growth is just about sufficient to maintain a stable population, while for Ruthenia the excess of births over deaths was 14.3 per thousand.

## SUMMARY

The loss of Ruthenia should not produce any great economic effects upon Czechoslovakia's future. From a fiscal point of view the region was a liability. It has been estimated that revenue from that province amounted to only about 50 per cent of governmental expenditures. While timber resources of Ruthenia were significant the Republic is, fortunately, well provided with forests. Continued importation of Ruthenian salt may prove to be a consequential drain on the Czech balance of payments with the U.S.S.R. Loss of the region's labor supply is a real hardship to the country's production effort.

Undoubtedly the Soviet Union gained more than Czechoslovakia lost. Here the gains are primarily of a noneconomic nature. The addition to the Ukrainian Republic brings the U.S.S.R. south of the Carpathians and gives it a common frontier with Hungary. Most important, it is a step in direction of silencing dissident groups interested in Ukrainian independence and which could use Ruthenia as a base for operations.

In their decision to expel the German minority the Czechs entered upon a course of action, the wisdom of which cannot be evaluated in terms of economic considerations. Viewed in realistic terms Czechoslovakia's treatment of its German population up to the war was as equitable as any minority could expect to receive. The results of that policy did not prove happy for the country. At conclusion of the war any course of action other than that taken by the government would have been contrary to the wishes of an immense majority of the people. From a legalistic point of view the action was justified in that this segment of the population had identified itself with Germany and had, to all intents and purposes, forsaken Czechoslovak citizenship. The government and the great mass of the people of the country were quite cognizant of the magnitude of the economic problems to be created by the expulsion of the Germans.

Many years will probably pass before the absolute productivity of Czech labor reaches the standard attained before the removal of the Germans. Through increased use of the other factors of production, total production can regain its former level. The level can be attained only through sacrifice and gainful employment of a much larger proportion of the population than before the war. It is inevitable that loss of the highly productive workers represented by the three million Germans expelled will depress the standard of living in Czechoslovakia well into the future. Nationalization of industry, tremendous changes in prices, and intensive economic planning will so modify the course of development of the Czech economy that it will be virtually impossible to assay the ultimate consequences of the population change, considered by itself.

# AUSTRIA: HER RAW MATERIALS AND INDUSTRIAL POTENTIALITIES

*George W. Hoffman*

AUSTRIA, with an area of 32,369 square miles is somewhat larger than South Carolina. Located in the center of Europe, it is surrounded by seven countries and is on the crossroad between the North (Germany, Czechoslovakia, Poland) and the South (Italy and Yugoslavia), the East and the West. Austria's total boundary is 1600 miles; its total length is 360 miles and its width, 183 miles.

The Alps cut across Austria from Switzerland to the Hungarian plains in an east-west direction, thus giving the country a complex topographic pattern which reflects upon distribution of its economic resources, land-use, and distribution of its population. The country is very rugged, as evidenced in the large local relief varying from approximately 11,000 feet to 1500 feet. Three-fourths of Austria's surface may be classified as mountainous, while only 5 per cent could be termed true plain. Because of rugged relief, nearly 11 per cent of the total area is unproductive, the barren portion amounting to 25 per cent in the Hohe Tauern and to 34 per cent in the Central Austrian Alps. Almost 41 per cent of the productive area of Austria is cultivated as farmland, meadowland, gardens, and vineyards, while 59 per cent is devoted to forests and natural pasture. The richest farm land is found along the Danube (Donau) Valley with its alluvial deposits and in the Province of Burgenland bordering the Hungarian lowland, an area now largely occupied by the Soviet Union.

The country had a population of 6.8 million people in 1937. After taking war losses and large scale immigration of Volksdeutsche (Volksdeutsche are former German settlers of neighboring countries, such as Hungary, Rumania, Yugoslavia, and Czechoslovakia which either voluntarily or by compulsion have left their home and now are permanently or temporarily living in Austria) and other displaced persons into account, present-day figures of 7.14 million people are agreed to be only estimates.

The capital city of Vienna (Wien) is located at the crossroad of the old military and trade route connecting the South (Italy) with the North (Czechoslovakia and through the Moravian Gap—Poland) and the Danube River which served even in Middle Ages as important transportation artery and was used as trade exchange for grain from the lower and middle Danube region with manufacturing items from western and central Europe. One and a half million people live in the city, which is now subdivided into four occupational zones.

For a long time Vienna and the Vienna (Wiener) Basin was the center of trade and industrial production not only for Austria, but for most of central and southeastern Europe. Under the old Austro-Hungarian Empire, industries of Austria and those of Bohemia and Moravia were economically interrelated. Vienna depended upon food supply of the Hungarian plains, which in turn received their agricultural implements from Austria. Shifting boundary lines, political reorientations, new customers,

export and import restrictions and two wars have changed the relationship, until today Vienna's importance as commercial and industrial center is rapidly declining. In addition, the center of gravity is slowly shifting from Eastern Austria to the Linz-Wels-Steyr triangle, Salzburg, and Innsbruck industrial regions in the west. The movement, begun shortly before World War II by miscellaneous industries, was accelerated by Germany's plans to escape Allied bombings, and is now continuing as light manufacturing plants are being moved from the Russian to the American and French occupation zones.

## RAW MATERIALS

With exception of coal, Austria is fortunate in having considerable deposits of minerals, iron ore, salt, talc, gypsum, magnesite, oil, and others. The iron ore deposits of Styria are of excellent quality, and prewar production was sufficient to meet domestic requirements and to allow for substantial exports. Magnesite is an important export item. Before the war, Austria was second only to Soviet Russia in production of magnesite. In 1937 substantial quantities of ores were exported to Germany, the United States, and Great Britain.

The accompanying map of Austria shows approximate distribution of the more important raw materials. Table I compares extraction of these resources in the years 1937, 1946 and the first six months of 1947. It also gives an estimate of their distribution throughout the various occupational zones.

TABLE I

AUSTRIA: RAW MATERIALS, OUTPUT AND DISTRIBUTION

| | *Output (in 1000 t)* | | | *Distribution over Occupational Zones (in %)* | | | |
|---|---|---|---|---|---|---|---|
| | *1937* | *1946* | *6 Months 1947* | *USA* | *USSR* | *UK* | *French* |
| Antimony | 2.0 | 0.8 | 0.5 | ..... | 100.0 | ..... | ..... |
| Barytes | 0.8 | 0.7 | 1.1 | ..... | 100.0 | ..... | ..... |
| Coal: Bituminous (Stein) | 230.0 | 108.0 | 86.0 | ..... | 100.0 | ..... | ..... |
| Lignite (Braun) | 3,240.0 | 2,402.0 | 1,370.0 | 10.0 | 6.0 | 80.0 | 4.0 |
| Copper* | 7.2 | 5.5 | 8.0 | ..... | ..... | ..... | 100.0 |
| Graphite | 18.0 | 0.3 | 1.1 | ..... | 65.0 | 35.0 | ..... |
| Gypsum | 5.0 | 0.5 | ..... | ..... | 100.0 | ..... | ..... |
| Iron Ore | 1,884.0 | 460.0 | 360.0 | 4.0 | ..... | 96.0 | ..... |
| Kaolin | ..... | 4.0 | 29.0 | 100.0 | ..... | ..... | ..... |
| Lead** | 113.0 | 34.0 | 16.0 | ..... | 2.0 | 90.0 | 8.0 |
| Magnesite | 398.0 | 95.0 | 97.0 | ..... | ..... | 100.0 | ..... |
| Oil*** | 34.0 | 846.0 | ? | ..... | 100.0 | ..... | ..... |
| Salt | 81.0 | 78.0 | 45.0 | 75.0 | ..... | 20.0 | 5.0 |
| Sulphur | ..... | 4.0 | 3.0 | 90.0 | ..... | 5.0 | 5.0 |
| Talc | ..... | 2.0 | 9.0 | 30.0 | 70.0 | ..... | ..... |

*Copper content of 1937 production was 117 tons.

**Only joint figure with zinc available.

***Highest annual production: 1944—1.4 million tons. 1946 figure is estimated by Austrian Government. City of Ebensee, American occupation zone has a large and newly built petroleum refinery.

Gold, Silver, Bauxite, Manganese, Nickel have small and irregular production.

*Source:* Statistisches Handbuch fuer Oesterreich, 1937; Monatsberichte des Oesterreichischen Institutes fuer Wirtschaftsforschung, Mai and August, 1947; Distribution figures are estimates by Gypsum, Sulphur, and Talc.

Considerable progress has been made since the end of World War II in the extraction of the raw materials, but deficiencies in fuel, manpower, foodstuffs, transportation, and to some extent war damages, have created heavy handicaps in returning to prewar production.

Lack of adequate fuel is a prime reason for most of Austria's economic

problems. Domestic lignite production in 1946 reached 75 per cent of the 1937 production and bituminous production not quite 50 per cent. Both figures should be considerably improved in 1947. While Austria could produce 90 per cent of her lignite needs, she depended upon an annual import of more than three million tons of bituminous coal. Before the war, Silesia contributed nearly 80 per cent of Austria's needs. In 1946, 86 per cent

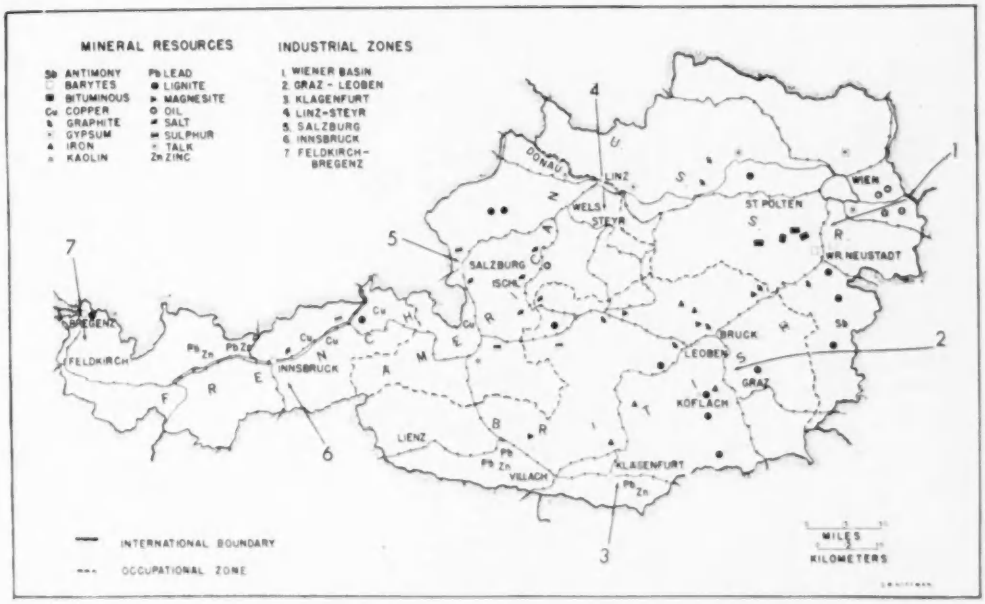


FIGURE 1.—Austria: Mineral Resources and Industrial Zones 1947. The distribution of minerals as related to the several industrial zones and the zones of occupation is at present of great importance in the solution of Austria's many problems, both political and economic.

of her imports were from the Ruhr; in addition to being farther away, they were not dependable. A rather recent trade-barter agreement with Poland should improve Austria's coal supply.

An entirely different picture is shown in the petroleum situation. Austria's production increased from 34,000 tons in 1937 to over one million during the war. Since domestic needs are estimated at 600,000 tons, there should be a sizeable export surplus, which could easily be bartered for bituminous coal. Unfortunately all of Austria's oil fields are located within the Soviet Russian occupation zone, and are being claimed as German property by reason of their expansion during the German operation. The Austrian market received very little during 1946 and the latest offer by the Russians was the formation of a 49–51 joint stockholders company between Austria and the U.S.S.R. (At the Potsdam Conference in 1945, it was officially announced that the Allied Powers would not seek reparations from Austria. Both the U.S.S.R. and France interpreted the provisions differently and claimed and confiscated much Austrian industrial equipment which originally was confiscated by the Germans. The Soviet Government also claimed title to German-held shares of companies with headquarters in eastern Austria, even if their property was located outside the Russian Zone. Danube Shipping, the important Alpine Montan Company [Iron Ore in the

Province of Styria] and several important Banks and their holdings fall subject to this interpretation.)

Electric power in Austria has also undergone considerable expansion during the years of German occupation. Production facilities increased during the war, permitting an increase of from 2.6 million kw-hours to approximately 6 million kw-hours in 1944. Hydroelectric plants built, but not completed during the war, include the new large generating plant at Kaprun in the province of Salzburg. According to latest information, construction is being resumed on this important plant. Important also are two plants on the Inn River, their power being directed to the newly built aluminum plant at Ranshofen, Province of Salzburg. The plants are located on the German boundary and until ownership questions are settled supplies are equally divided between Germany and Austria. There are hydroelectric plants in two unconnected areas of the western provinces. In the eastern part of the country the thermal system predominates. In addition, plants located in western Austria are not fully connected with the rest of the Austrian system. Most of the power from the western provinces was exported to Germany. With closer integration now planned increased production facilities should be of considerable benefit to all Austria, but final solution for the fuel problem cannot be hoped for in the near future, not only because of slow building progress and difficulties in installation of complicated machinery, but also in expansion of household and industrial needs during the last ten years.

## INDUSTRIAL PRODUCTION

Austria's industries developed in the decades preceding the First World War as part of the larger industry of the Austro-Hungarian Monarchy. Breakup of the Empire left it a truncated body. Bohemia specialized in cotton weaving and Austria in spinning. Similarly iron and steel industries depended upon coal of the Austrian-Silesian (now Polish) coal region. Slowly Austrian industry adapted itself to the new conditions, but in 1937 Austrian textile industry still had surplus of spindles and deficiency in looms. Nor was the steel industry fully adjusted. The sugar industry, railway industry, and chemical industry are other examples of this maladjustment. Chronic unemployment resulted even in the years of a general European recovery.

In analyzing Austria's present industrial capacity it is necessary to point out that despite considerable bomb damages and the general ravages brought about by the occupation, industrial capacity is now larger than in 1937.

During the war, great expansion was undertaken in iron, steel, aluminum, machine tools, chemicals, petroleum refining, and other products. The following table gives a concise picture of the employment situation from 1937 to 1947.

TABLE II

AUSTRIA: EMPLOYMENT IN SELECTED INDUSTRIES

| | *Per Cent of Total Employment* | |
|---|---|---|
| | *1937* | *1947 Estimate* |
| Iron, Steel, Engineering | 25.6 | 38.0 |
| Chemical | 7.0 | 10.0 |
| Textiles and Clothing | 10.7 | 8.0 |
| Leather and Shoe | 1.9 | 1.0 |
| Food and Beverages | 15.3 | 10.0 |
| Stone, Glass | 6.1 | 4.0 |
| Woodworking | 12.5 | 15.0 |
| Paper | 4.3 | 2.0 |
| Misc. | 16.6 | 12.0 |
| | 100.0 | 100.0 |

*Source: Statistisches Jahrbuch fuer Ostereich*, 1938; *Statistisches Handbuch der Stadt Wien*, 1938; *Monatsberichte des Oesterreichischen Institut fuer Wirtschaftsforschung*, 1946 summary in *Mai* 1947 issue.

Unfortunately, much of the expansion was for military purposes or for the needs of an economic unit serving 100 million people, and not for needs of a country of Austria's size. Some industries located in Russian occupational territory have been shipped to the U.S.S.R. Others located in the British and American Zones are either closed down or are working on reduced scale. Large-scale iron foundries at Linz, and aluminum works at Ranshofen, bear proof to unequal distribution of the country's industries. Austria is therefore faced with the problem of utilizing her new industries, considerably more difficult than after the First World War. Necessary raw materials are lacking; manpower is insufficient; and markets are not available for most of the products of the new industries. In addition, much new industry is uneconomic and cannot easily be converted to peacetime uses. The Austrian Government, with assistance of United States and British officials, has therefore wisely undertaken to promote first, re-establishment of industries which are directly contributing to the daily needs of the country and of which products can easily be exported either for barter or foreign currency. Table III lists some of the more important industries with their output.

TABLE III

AUSTRIA: PRODUCTION OF SELECTED INDUSTRIES

Output (in 1000 t)

| | *1937* | *1946* | *1947 (6 Months)* |
|---|---|---|---|
| Aluminum Industry | 4.4 | 1.0 | ? |
| Building Materials: | | | |
| Cement | 429.0 | 366.0 | 148.0 |
| Building brick (mill pcs) | 648.0 | 157.0 | 24.0 |
| Roof brick (mill pcs) | 128.0 | 41.0 | 32.0 |
| Iron Industry: | | | |
| Pig iron | 389.0 | 58.0 | 72.0 |
| Steel | 650.0 | 187.0 | ? |
| Rolled Steel | 427.0 | 122.0 | 97.0 |
| Nitrogenous Fertilizer | 6.3* | 32.5 | 22.0 |
| Paper Industry: | | | |
| Wood Pulp, mechanical | 110.0 | 32.0 | 20.0 |
| Cellulose | 304.0 | 40.0 | 22.0 |
| Paper and Cardboard | 294.0 | 110.0 | 47.0 |
| Automobile Industry: | | | |
| Passenger cars, trucks incl. rebuilt** | 6.1 | 1.6 | 1.2 |
| Leather Industry: | | | |
| Shoes (mill Pairs) | 4.5 | 850.0 | ? |
| Textile Industry: | | | |
| Cotton thread | 32.5 | 12.2 | ? |
| Wool thread | 8.4 | 2.9 | ? |
| Cotton fabric cloth (mill. meter) | 109.0 | 38.4 | ? |
| Wool fabric (mill. meter) | 12.3 | 3.0 | ? |

*Production figure from 1936.

**80% are rebuilt cars in 1946 and 1947.

*Source:* Monatsberichte des Oesterreichischen Institutes fuer Wirtschaftsforschung, Mai and August, 1947; International Reference Service, U. S. Dept. of Commerce, Vol. 4, August 1947, number 36, p. 3 and number 37, p. 1.

The chief industrial centers, as indicated on the map, are well distributed throughout the country, but even taking into consideration the slow process of the westward movement, the Wiener Industrial Basin is still leading in total production. The following Table IV shows the main industrial regions and their most important industries.

Great expansions, especially in war industries, have marked the last eight years. The following figures should

TABLE IV

AUSTRIA: MAIN INDUSTRIAL REGIONS

| *Industrial Region Approximate Output* | *Occupational Zone* | *Delimitation of Area* | *Main Industries* |
|---|---|---|---|
| 1. Wiener Basin 40% | USSR | 15 Mi. NW of Wien to 10 Mi. S of Wr. Neustadt. 20 Mi. in diameter | Agriculture Machinery, Aircraft, Automotive, Building, Ceramics, Chemical, Electrical equipment, Food processing, Furniture, Heavy Mach., Leather goods, Petroleum proc., Textile |
| 2. Graz-Leoben 20% | United Kingdom | Graz-Koeflach Leoben-Bruck 15 Mi. N and S of Leoben and Bruck | Agriculture Mach., Automotive Building, Chemical, Electrical Equip., Food Processing, Furniture, Heavy Mach., Iron and Steel, Pulp, Paper |
| 3. Klagenfurt 7% | United Kingdom | 20 mi. radius of Klagenfurt | Aircraft, Building, Chemical, Furniture |
| 4. Linz-Wels-Steyr 15% | USA—95% USSR—5% | Triangular area, both banks of Linz area | Building, Chemical, Electrical Equip., Food processing, Furniture, Heavy Mach., Iron and Steel, Lumber Ind., Petroleum Refinery |
| 5. Salzburg 7% | USA | Approx. 15 Mi. radius of Salzburg | Aluminum, Building, Chemical, Food processing, Furniture, Lumber Ind., Pulp, Paper |
| 6. Innsbruck 8% | French | Approx. 15 Mi. radius of Innsbruck | Building, Chemical, Food processing, Furniture, Heavy Machinery, Leather |
| 7. Feldkirch-Bregenz 3% | French | Area between two cities | Food processing, Furniture, Leather goods, Lumber, Textile |

give good comparison of production capacities between 1937 and 1947:

| | |
|---|---|
| Aluminum | 6,000 to 60,000 tons annually |
| Pig iron | 500,000 to 1.5 million metric tons |
| Ball bearings | 1.5 million to 10 million pieces |
| Nitrates | 1,500 to 61,500 tons |

Unfortunately, most of the increased capacity means little for the small country, which has neither raw materials, manpower, nor export possibilities.

The present industrial production is still far behind the last peacetime figures and only when industries can depend on a steady flow of raw materials and fuel will it be possible materially to increase output. In addition, the four-power occupation of such a small area, with their different directives and goals, makes it extremely difficult for Austria to plan her own destiny.

Present information makes it quite conclusive, that many newly established industries have little or no value to the economic well-being of the country. If a number of them, especially those serving war needs, should be confiscated and shipped to Soviet Russia, it would have hardly any bearing on the economic future of the country. More serious would be the situation if Soviet Russia continues to insist on confiscation of machinery and tools needed for ordinary peacetime production. Latest information available gives a picture of large-scale decreases in important tool machinery. The following table gives figures on the actual tool machinery available at selected dates:

TABLE V

AUSTRIA: TOTAL TOOL MACHINERY AVAILABLE

| | *December 1937* | *April 1945* | *January 1946* |
|---|---|---|---|
| | *Figures in Pieces* | | |
| Electro Industry | 12,038 | 19,327 | 7,896 |
| Automotive Industry | 13,508 | 21,043 | 8,777 |
| Machine Industry | 8,868 | 18,096 | 7,276 |
| Iron and Metal Industry | 23,693 | 29,471 | 23,681 |
| Steel and Pig iron Industry | 2,624 | 4,296 | 1,981 |

*Source:* Oesterreichisches Institute fuer Wirtschaftsforschung, Mai, 1947.

Depletion in important tool machinery—a key item in the industrial production—is proof of the seriousness of the Austrian industrial production, especially when it should be understood

that most confiscated machine tools were of latest design. It is clear that much reorientation in Austria's industrial output is necessary; but the country is fortunate to have skilled labor and experience in industries such as the manufacture of machinery, metal goods, automobiles, optical instruments, textiles, and clothing, leather goods, ceramics, and porcelain. With adequate fuel and raw material supplies, previously mentioned industries, together with the iron, steel, aluminum, etc., industries should give the country good basis for prosperity.

## POSSIBILITIES FOR ECONOMIC DEVELOPMENT

Austria's incorporation into the Greater German economic unit had far-reaching results in her total economic structure. The new industrialization, based partly on her peacetime industry, has changed not only Austria's internal relationships, but affected her place in Europe's economy. The large increase in her pig iron capacities with the building of the United Iron and Steel Works in Linz (formerly Herman Goering Works), gave Austria one of the largest and most modern networks of blast furnaces, steel assembly plants, and chemical works in the whole of Europe. The former coal supply from the Ruhr and Upper Silesia is now largely cut off, but attempts have been made to induce Poland, Czechoslovakia and France to supply coal in exchange for pig iron. The question of future markets is of utmost importance. Similar examples could be shown with other over-expanded industries, in each instance low raw material supply is the biggest handicap.

In any question of Austria's economic future establishment of industries or modernization of existing industries has top priority. Enlargement of canning industries, especially the apple industry, has long been under consideration. Market for goods of Austria's established automotive industry is readily available, but raw materials again play a decisive role. The country has much need for housing facilities. It has skilled labor supply but modern machinery needed for production is totally absent. There has been little change in the housing situation since 1937 because housing is not a wartime industry.

Austria's geographic location makes it one of the crossroads in the international air and road traffic pattern of Europe. Large-scale improvements in railroad equipment are urgently needed. The number of locomotives has decreased by approximately 30 per cent the prewar figure. In June, 1947, Austrian railroads transported 60 per cent more passengers than in 1937 with nearly 50 per cent less equipment. Accident rates have increased nearly 100 per cent. Highways need repairs and new roads are imperative if the country is to play important part in the tourist industry again. Erection of modern civilian air facilities and terminals has been proposed. The question of a Free Harbor, preferably at Trieste, is of utmost importance for her international trade. Transportation and tourist traffic are so closely interrelated that urgent attention should be given them if the country's economic outlook is improved.

Waterpower, either for fuel or for irrigation and drainage, is high on the list of future economic developments. The Central Alps and the Hohe Tauern are the source of numerous rivers which at the present time have not been harnessed. A "TVA for the Danube" has been proposed and should offer large opportunities for the country. Dredging and improving the Danube

for navigation is of utmost importance for all of central and eastern Europe. While Austria has enlarged her power capacities over 100 per cent since 1937, it should be possible to increase output to a total of 25 million kw-hours, further increase of nearly 20 million kw-hours. If such production could be reached, the ever-present fuel problem could be solved. Hand in hand with waterpower goes electrification of the railroads. While approximately half the trunk lines have already been electrified, the rest of the trunk lines and nearly all secondary lines are awaiting expansion of electric power.

The future of the petroleum industry involves another raw material with great possibilities. Additional drillings before and during the war have shown considerable deposits as yet untapped. Oil from eastern Austria (Zisterdorf, 15 miles east of Wien) is of utmost importance, not only for satisfying domestic needs but also in exchange for other necessary raw materials with countries like Czechoslovakia, Germany, Switzerland, and Italy, which have little or no oil. It should be noted that fully eight per cent of Austria's prewar imports were petroleum and petroleum products. Combining the importance of petroleum and waterpower and their influence on the importation of more than three million tons of coal a year, it can easily be seen what such a shift in the country's fuel requirements means in terms of trade balance and steady supply of the country's industries.

It is not the purpose of this brief survey to discuss agriculture in Austria, but it should be pointed out that future improvements and plans for utilizing the country's water reserves should have important effects on it. While few areas would benefit from irrigation, the easternmost province of Burgenland, one of the most backward regions of the country, offers an opportunity for reclamation and irrigation farming. Increased output of agricultural products should be of benefit to the whole country. At the same time, the question of wartime exploitation of timber resources, and peacetime need for some wartime crops established by the Germans, like soy beans and tobacco, has to be answered in terms of the total economic needs of Austria.

It can be seen that Austria has large reserves which make it one of the richest and at the same time one of the most balanced economies of all European countries.

While many improvements have been made during the years 1920–1937, the transition from a country largely dependent upon commerce and trade and some restricted industries, to a self-sufficient unit with a well-balanced economy, could not be completed in such a brief period, especially considering external factors, such as the growing power of Germany and the storm announcing World War II. Much will depend again on these external factors and as long as the country is occupied by four powers little can be accomplished. But it is the writer's opinion that with abundance of waterpower, petroleum, iron ore reserves, and other mineral resources and advantage of the geographical location, the future of an independent Austria's economic development in a peaceful world economy can easily be established.

# "HIGH FARMING" IN SOUTHWESTERN ENGLAND, 1840–1880

*G. E. Fussell*

FARMERS of the five southwestern counties of England have always found their advantage in paying the larger part of their attention to production of livestock and livestock products, although on the chalk hills of Dorset and Wiltshire there have been, since the days of their enclosure, some large arable-sheep farmers whose modern economy was based on adoption of the Norfolk 4-course husbandry. In Somerset, Devon and Cornwall most farms were small, and here again with some exceptions in Somerset, livestock production was the chief employment. The four decades 1840–1880 have been called the period of "High Farming" in England and there were large scale farmers, men of capital and enterprise in most parts of the country, but their numbers were probably limited and their influence perhaps exaggerated: it is difficult but not impossible to establish from the contemporary evidence how widely what was then regarded as "High Farming" was the practice in the five southwestern counties of England.

## Dorset

Dorset dairies and Dorset Horn Sheep have always been famous, produce of the dairies being butter and "blue" cheese in days before modern transport turned them to liquid milk for urban populations, and so in 1847 a French visitor found most of the county in pasture with just those objects in view, but the countryside was dull and uninteresting to him,[1] a conclusion incomprehensible to me, a native of the county, and certainly not shared by an American[2] who walked across it twenty years later. From Shaftesbury the fertile and picturesque Vale of Blakemoor stretching far and wide was a scene of natural and artistic beauty. It was almost entirely devoted to production of milk, butter and cheese and in many fields there were from thirty to forty cows. A wayside innkeeper told him that he had managed a 50-cow dairy with the help of his wife, two children and a young hired man. The fifty cows averaged about 4 lb. butter a week and about 150 lb. skimmed milk cheese in the season. A higher yield of 6 lb. butter had been averaged by 40 cows on upland pasture. The cows kept were mainly of the Red Devon breed and the butter was sold in Portsmouth and London, the rock-like cheese being kept for home consumption.

The Dorset Horn Sheep, which lambed early, either in December or January, were renowned for twinning, and were kept for production of what was known as house lamb, the young only being kept a brief while before going to the butcher as a great luxury for the rich in London. The so-called Portland breed were really a smaller Dorset and the system on which the sheep were kept was at grazing on the down by day and folded at night. They were useful to consolidate light land, their little feet having much the effect of the Crosskill roller used in Yorkshire. The ewes were sold in-lamb when 4 years old at Weyhill and other fairs to

London dealers and some went to Hertford for lambing and production of more house lamb.[3]

Amongst crops grown were some hemp and flax, the former used in the rope walks at Bridport, some sainfoin on the Chalk Downs in central and south-western parts of the county, and potatoes at Bridport, Beaminster and Abbotsbury, sown at the rate of 24 bushels of potatoes here yielded as much as 360 bushels an acre. They were set in every third furrow and moulded up with the double mouldboard plough: but they were the more unusual crops. On uplands where arable-sheep economy was practised, the Norfolk 4-course rotation was usual, extended to a 5-course on some farms where the seeds were left down for two years.[4] Here farms were large and occupied by men of capital as Downland farms were all over England. James Harding of Waterson Farm near Dorchester had

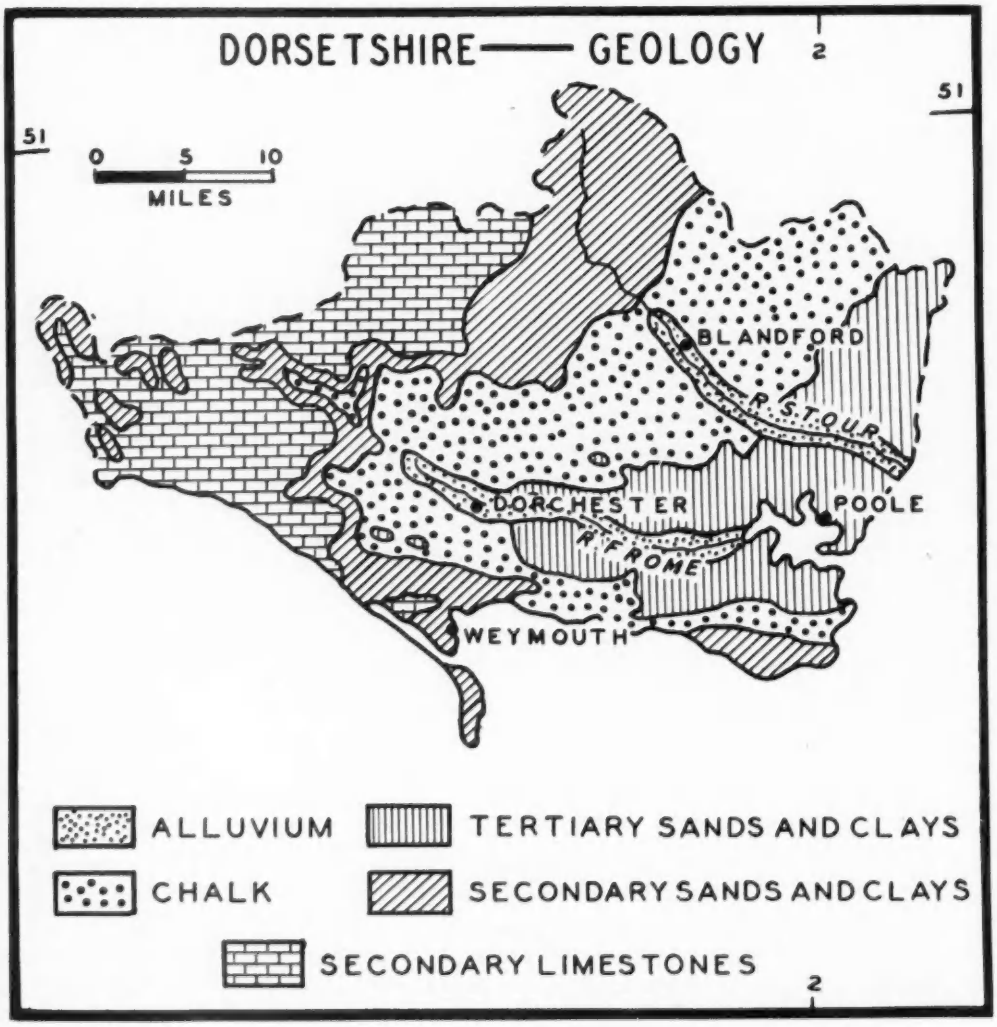


FIGURE 1.—Farming areas of Dorsetshire correspond rather closely to the geology of the area. Soils derived from some of the outcropping formations are much better adapted to successful crop growing, grazing, or other types of farming than others. (From Louis H. Ruegg, *Jour. Royal Agric. Soc. Eng.*, Vol. XV, 1854.)

succeeded his father there and between them they had occupied 1,100 acres for fifty years on a year to year tenancy with no custom of compensation for improvements. Yet he, like other tenants of large acreages, often two or more farms, was going in for improvements. He chalked the land at a cost of £2 an acre to get the benefit on the 4th year's crop and to find the benefit exhausted after the 8th year's crop: and even so he only got smallish yields hardly up to the national average of his day. These were 20–22 bushels wheat an acre; 32 bushels barley; 30–40 bushels oats. He had broken up 140 acres of maiden Down to grow arable crops, his landlord paying cost of the first banking, plants and fence, i.e., the bank on which the plants were sown to form hedges. According to him a good deal of drainage had been done in the Vale of Blakemoor where the heavy grassland certainly required it and he held the opinion that if a tenant did this he ought to be compensated for its unexhausted value when he left as well as for bones, guano, fences and new orchards.[5]

On the Downlands in the prosperous days of the French wars and even afterwards the 140 acres broken up by James Harding was small part of the same sort of work that had been done partly in the first half of the 19th century but some during the previous century. No exact estimate of the area can now be made but it was put at thousands of acres by a contemporary, Louis H. Ruegg, in 1854; there was then no better farming in the kingdom than from Woodgates to six miles beyond Dorchester and it was all worked on the arable-sheep system with a 4 or 5-course rotation according to the soil.

Amongst the great landlords who set an example of good management in the district was Lord Portman who farmed at Bryanston. His system was only different from that of his neighbours by his use of a "milking-pound," a contrivance re-invented by a Wiltshire farmer named Hosier as a "milking bail" in the period between the two World Wars. The milking pound was formed of a number of larch frames, wattled with hazel and mounted on low wheels. It was easily drawn from place to place by the dairyman's pony by which means the place of milking was shifted, and the manure was evenly distributed over the meadow. Another, Farquarson of Langton had 4500 acres in hand, managed by Scotch bailiffs on the 5-course plan. Part of the ley was ploughed early in May, and sown to rape fed off by sheep before sowing wheat in autumn. He also grew 80–100 acres of Italian rye grass and occasionally French grasses (sainfoin or lucerne) in place of clover. He had a flock of 6,000 sheep, all pure bred, 40–50 fatting bullocks, and 60 working oxen worked by reins in pairs. He had a steam threshing machine, the mark of the up-to-date farmer of the day. H. C. Sturt was another user of steam power on his estate at Critchell, both for threshing and for driving barn machinery, and so did his tenants. Ford of Rushton Farm made a feature of fattening Hereford cattle and Damon of Winfrith went in for fattening beasts and sheep with oilcake and used large quantities of artificials. He was reputed so to have improved his land that he fattened a score of beasts in 1854 where one had been grazed before. Thomas Homer Saunders on the 900 acres of Watercombe Farm varied the usual rotation into, wheat; barley the stubble sown with vetches; turnips or swedes, barley, clover for 2 years. On Warmwell Farm he extended the rotation to occupy seven years, and used bones, superphosphate, a compost of pig's

dung (he had 150 head), as well as heavy dressings of dung on his roots, but used oxen for farm work. He had 781 lambs from 652 Down ewes in that spring. He kept 500 poultry. Lord Rivers, who owned 30,000 acres, had two farms in hand and other well-known farmers were James Caines of Cheselbourne; Henry Fookes of Whitchurch; E. St. V. Digby, Minterne; Anthony Huxtable, Sutton Waldron. Saunders was not so much of an exception in using working oxen as might be thought. A great many Red Devons were kept near Dorchester. They were bought at 3 years old, worked 2 years and then grazed and sold. A great many young heifers were bought and sold at 3 years old with a calf by their side to the dairies. Some parts of the excellence of the turnip husbandry was result of the cups offered by the local agricultural societies.[6]

Writing on *The maintenance of fertility in arable land* in the Journal of the Ministry of Agriculture for March 1942, W. S. Mansfield remarks that the saying "where there's muck there's luck" still rings true, and it was a dictum heavily subscribed to by the farmers of Thomas Hardy's Wessex, and more particularly by one of them, the Rev. Anthony Huxtable, whose system came in for consistent admiration from all the pundits of the day. His farm had, of course, been improved by all current methods of deep draining, subsoiling and liming; heavy manuring, complete soil comminution, stall feeding, and there was a wide range of implements and strong horses on the farm as well as steam power for threshing, grinding and chaff-cutting. But most of his energies were devoted to making manure at home and using it there. His cattle were box-fed standing on "sparred" floors for keeping them off the cold stones of the original floor. Sheep as well as beasts were stall fed and fattened economically on much less feed than was necessary to get them into marketable condition on any other system. Remarkable care was taken of the liquid manure. Every drop was collected in tanks from which pipe lines through which it could be pumped led to the fields.

The solid manure was carefully collected and composted with such materials as burnt clay, ashes and bone dust in alternate layers to form a manure capable of being drilled with the combined drill or dropped into dibble holes for the turnip or mangold crop. Huxtable also bought fairly large quantities of guano, and made a chemical manure by dissolving 1 cwt. of salt in 18 gallons of water adding 268 lb. of crushed bones and pouring 1 cwt. of sulphuric acid over the mass. The resulting compound was said to be superior to ordinary superphosphate because it contained a large quantity of muriatic acid.[7]

The water meadows in Cranborne Chase were not new but their management was a skilled undertaking and John Baveystoke Knight of West Lodge, Piddleton was reputed in authority, the recipient probably of traditional knowledge.

The Vale of Blakemore, low-lying, wet and heavy, was confined to rearing and grazing and to the dairy. Drainage was necessary but rather neglected, although some had been done on the larger properties. The fine beef oxen were sold in local markets or to Poole and Portsmouth: the fine fat pigs produced with dairy waste products went to London. Young cows were bought for the dairies of North Wilts. Ruegg calls the cattle Dorset long horns but they were, I believe, mainly Red Devons. Marshwood Vale on the cold Lias clay of south west Dorset was a terrible rough country, presumably of

little improvement, mostly dairies producing Dorset butter, but of a go-as-you-please system of arable farming. The flax crop, formerly occupying some 4,000 acres here was vanishing, not 300 acres being grown in 1854. This was the country that a Londoner found so uninteresting to walk through in 1855 that he took a coach from Weymouth to Charmouth, a half forgotten vehicle then rarely seen in the Home Circuit, but even so about to give place to railways that would soon be built to Weymouth.[8]

At the other end of the county was the Isle of Purbeck given up to stone quarrying, and some farming of much the same type as the other upland, and the wild heaths of Canford Chase stretching across Bere Heath to the foot of the chalk downs.

The system of letting dairies of cows practised all through the south west and of immemorial antiquity intrigued Elihu Burritt greatly and was more particularly described by Mr. Tucker of Bridport. On farms of sheep, corn and dairy land the cows were let off to dairymen at £9 or £10 each per annum from Candlemas (Feb. 14) and part of the farm was allotted to the dairymen at the rate of 1 to 1½ acres for summer keep per cow rented, plus about the same quantity of meadow land in autumn, and as much hay as the cows will eat between calving and May 12. The land reverted to the farmer after the cows went dry and were kept in straw "bartons or yards," and sheep turned into the pasture for the winter. The farmer provided a house and buildings for the dairyman and fuel for dairy purposes. The rent was paid quarterly, the calf often paying the first quarter and the rearing and fattening of pigs on waste dairy products was a profitable source of income to the dairyman who was also expected to work for the farmer at day labourer's wages in hay time, sheep shearing, harvest and other occasional works. Devon cows were the most common, but on some farms Channel Islands cows at 1 per cent of the herd were used to improve the milk, and shortly before 1856 some Hereford, Durham and Ayrshire beasts had been imported. The Devon heifer calves were sold to Devon graziers who kept them and sold them as cows at 2–3 years old. About one in five was kept for replacement.[9]

The method by which the Chalk Downs had been broken was much the same as that employed on similar land, e.g., Lincoln Heath, elsewhere in the country. In Dorset and Wiltshire the shallow turf was pared as thin as possible with a breast plough, and burnt in small heaps, the ashes being carefully spread. The land was shallow rafter ploughed and the unploughed part cut with the breast plough. The land was then well manured and left till autumn when wheat was sown broadcast and harrowed in. The next year turnips were grown and fed off with hay or chaff, rape followed and this too was fed off in August or September when another crop of wheat followed. Much of this land could then be farmed on the arable-sheep 4 or 5-course system described, but on the more shallow soils it must then be seeded down to grass again for several years.[10]

By way of contrast to the seemingly primitive breast plough Mr. George Barnes, agent for Mrs. S. C. Hawkins, Alton Pancras, Dorchester, bought a set of steam tackle including the necessary engine, a cultivator, a side drag-harrow and a large drag harrow, the only one in the county in 1866. With it he was able to cultivate from 5 to 9 acres a day burning 1¼ cwt. of coal an acre. The engine, a portable, was used for threshing also, but to move the

machinery took the labour of ten horses and half a day's time for what distance is not stated.[11]

Very little change took place up to 1880. The system had become fairly stable by 1840 and though some more Down may have been broken up in the four decades the type of farming did not change. The disasters of the 70's bore most heavily on the flocks which declined by 100,000 in 8 years although the herds had slightly increased in the same time. The chalk land management had become rather more diversified and was still of an extremely high standard so there was less depression here than in some areas. The railway had by now made it possible to send liquid milk to London from the Blakemore Vale, cheese and butter still being made from what could not be disposed of in this way: but the Marshwood Vale clays in the West were in bad case. Butter was sent to London twice a week from here and the Dorset Horn sheep were used for producing early lamb: elsewhere the Dorset Horn ewes had begun to be crossed with Down or cross-bred rams.[12]

One of the most famous Dorset herds of Red Devon cattle had been formed at Toller Whelme by the Pope family in the 17th century and early in the 19th century the last William Pope did his best to make this herd dual purpose. He produced a cow that was a good milker, hardy enough to thrive on his high cold hills and of a quality to fatten out well. He used bulls from the famous herds of Quartly, Merson and Davy and occasionally a heavy beast from the Vale of Taunton and his bulls were widely used all over Dorset. This herd was dispersed by the Rev. W. J. Pope in 1884 but some of the beasts stayed on with the new owner of the place.

Another herd, not so ancient, was founded by a Mr. Shetter in 1805 and brought to New Barn Farm, Abbotsbury in 1830. He used bulls bought in Devon and some from the Toller Whelme and Little Toller herds. His herd was dispersed in the 1870's. Another famous herd was brought to Bradford Peverell about 1850 and Mr. Brook of Brinsmore Tree near Yeovil had a herd based on Quartly and Davy beasts. A family named Yeates kept another pedigree herd at Toller Fratrum for the same space of time. It was dispersed in 1876.[13]

The farming over most of Dorset, especially the arable-sheep economy of the uplands was of an excellence during the four decades, but the standard had been set here before the period opened. How far did it spread during the so-called forty years of high farming? That is impossible to say. The new manures were being used, the new feeds were grown and cake was bought, steam power was sporadically used, new and improved implements were doubtless obtained and great attention was paid to the sheep and the cattle—but all this is easy generalising: there is no statistical measure of any part of it.

### WILTSHIRE

Physically Wiltshire is divided into two parts, the chalk hills of the south including the wilderness of Salisbury Plain and the flat lands of the north of the county that stretch into Gloucestershire. The former was already famous for its large farms, flocks and corn in 1844 and the small pasture dairy farms of the north were equally renowned for dairies, cheese and grazing.

The chalk downs of the south had always been large farms even in Tudor days when they were only sheep walks, but were already beginning to be enclosed here and there for arable. By 1847 Lavergne estimated that farms in this part of the county ranged from

1,000 acres to 3,000 acres and were occupied by wealthy men of enterprise but he entered a caveat. "Large farming is beneficial," he wrote, "when it reduces the expenses of production, but it is useless when it increases them. There is a limit to everything." Sussex Weald farms were too small; South Wiltshire farms were too large.

The large scale farming was not on such a uniform system as that of the Downland in Dorset. Some was still on the old 3-field system of winter crop, spring crop, fallow, some was sown with wheat each alternate year, but some on a 4-course of wheat; vetches or turnips; barley, clover and when the land was clover sick vetches were grown as a catch crop before turnips and rye and the area of clover was reduced in the seeds year. On some of the lighter lands the rotation was wheat; swedes or turnips; oats or barley; grass for 2 years broken up for rape and vetches; on some of the heavier clover was only sown on one third of the seeds area the rest being cultivated with swedes, beans, oats, peas or vetches but clearly everywhere there was a heavy emphasis on fodder crops. On some farms spring wheat was sown after roots and drilling was "almost universal" except on the heavy land; and this was at least one sign of advanced farming in 1844. The water meadows on the banks of the streams had been important, some 20,000 acres having been made in the previous two centuries, but the new fodder crops had reduced their value.

Bones were used on turnips but only at 16 bushels an acre and were occasionally mixed with ashes in the proportion of 10/15 bushels bones and 20/30 bushels ashes. Guano, then a recent importation, was not extensively used but nitrate of soda, also new, was recommended as a good top dressing for wheat. Ley or wheat stubble was prepared for roots by paring and burning.

The cattle were a mixed lot but the Shorthorn Cross was popular; the Berkshire spotted pig was usual and the Southdown sheep in the majority, although a few Hampshire Downs were kept for fat lamb or grazing as tegs.

The old heavy Berkshire plough with a high gallows and two wheels was common but a few factory-made implements either one or two wheel had been bought from Tasker's new works at Basingstoke in the adjoining county of Hampshire. The Suffolk drill was used for corn and there were some broadcast machines. The harrows were "usual" and there were but few horse hoes. Clearly Wiltshire Down farming was neither so uniform nor so advanced as Dorset at this date.

On the soil of the smaller farms in the north bones were not much good as a fertiliser. The sheep fold and yard manure, which was reputed better made then in the south was the main dependance but soot was used as a top-dressing for wheat. Potatoes were popular and often the only root crop grown. Thirty years before practically all the cattle had been Longhorns but by 1844 Gloucester, Herefords and Shorthorn and all sorts of crosses were common, while on some of the poorer pastures farmers bred to maintain their herds. If possible calves were fatted before grass time and all the milk was used for making cheese.[14]

According to Rham the best arable farming district of the county in 1850 was Mere by Maiden Bradley, Warminster, Westbury, Lavington and Pewsey Vale from Burbage. Thomas Chandler of Stockton near Warminster, Chairman of the North and South Wilts. Agricultural Improvement Society, thought that improvement was hindered by the leases on which farms were held. These restricted tenants

to the old system of wheat, barley, grass and had not been changed to meet the recent advances in technique; again the absence of a custom of tenant right discouraged farmers from investing capital part of which might be lost in unexhausted improvements if for any reason they had to leave the farm. Chalking was very usual and ought to be compensated; bones, guano and oilcake would have been more freely used if compensation were customary. He had himself reclaimed 200 acres of rabbit warren by chalking, feeding the grazing livestock with corn and cake and then liming the land before breaking it up. He felt that there had been a great improvement in downland farming in the 10 or 15 years before 1848, more artificial manures being used and more corn fed to stock. The rate of improvement would have been more rapid under a system of tenant right.

Henry Blandford of Poulshot near Devizes occupied 200 acres of heavy wet land which wanted draining as did the whole grazing district. He thought there were still a good many Longhorns but some Devons had been bought; from 2–2½ acres was necessary to keep a beast. The only cash crop grown in his neighbourhood was a small acreage of wheat; the barley was fed to pigs—Wiltshire bacon was famous—and beans to the oxen. Some bush and turf draining had been done but Blandford thought the landlord should bear the whole cost of pipe-draining with 1″ pipes at 30′ apart[15]—a costly business.

On the great farms and large fields of South Wiltshire it was natural that immediate advantage should be taken of steam ploughing and cultivating machinery but there are conflicting reports of the number of farmers who bought this equipment. One enthusiastic Wiltshireman, Mr. Squarry (Squarey?) read a paper to the Bath and West of England Society in 1866 and said that perhaps in no district had it been so widely applied "for on the estate of one nobleman only no less than nine steam ploughing or cultivating apparatus are at work."[16] It is true that Mr. J. Allin Williams of Baydon was one of the pioneers and turned his malt house into a foundry ultimately securing two patents which he let to Fowler's of Leeds but, including him, only five farmers, three of whom lived in the north of the county, were included in the Royal Agricultural Society's Report on Steam Cultivation of 1867.

As in Dorset there were some outstanding farms in Wiltshire but none perhaps that achieved the fame of that of the Rev. Anthony Huxtable. One was occupied by James Rawlence and was really composed of two holdings, Bulbridge and Ugford near Salisbury. Two others were in the north of the county, that of Edward Middleditch at Blunsdon near Swindon being the most in repute, the other occupied by H. J. Marshall at Poulton Cricklade.

Rawlence's two farms totalled 955 acres of which 750 were arable, 106 water meadow on either bank of the River Nadder, and 70 pasture and orchard. It was in effect a characteristic South Wiltshire holding worked on much the lines given above, with rather more emphasis on green crop than corn. The stocking was heavy 876 Hampshire Down breeding ewes being kept and in the winter of 1867–8 406 tegs were carried. There were 20 young and 15 older rams, the whole flock numbering about 1300. The wethers were sold as lamb in August and rams either let or sold. A dairy of 35 cows, of which 10 were yearlings was maintained, and as a result of the sheep fold and the yard manure the white crops were exceptionally heavy for the type of soil. The Suffolk drill was used and

the wheat was horse hoed in spring. Reaping was partly done by machine and threshing by steam and some steam cultivation was done. Grass seeds were sown with a seed-harrow. Top dressings of guano, nitrate of soda and salt were used and cake was fed to the herd of cross Shorthorn and Alderney or Shorthorn and Devon cows. The number of horses used on the farm had been reduced from 22 to 17 since the introduction of steam cultivation.[17] This was a good example of a large scale arable-sheep farm in South Wiltshire.

Edward Middleditch was as much an innovator as John Prout in Hertfordshire. He must have been an extremely wealthy man, prepared to sink enormous amounts of capital in the farm of 700 acres including 100 acres of grass which he bought in 1866 for £70 an acre, an enormous price for those days. He grubbed 11 miles of wide, worthless, wasteful hedgerows and ploughed out 180 acres of poor sour wet grass making large fields of his retentive strong clay loam. He drained continuously and often had 100 men at work excavating 4 feet deep for pipe drainage. He began ploughing with horses but in 1871 bought a set of Fowler's steam ploughing apparatus including scarifiers and other implements with which he did contract work as well as his own. Wheat was his main crop and he had grown five crops in direct succession using 2 cwt. superphosphate, 1 cwt. nitrate of soda, and on some 6 cwt. Bristol manure, "blood and bones" drilled with 1 cwt. kiln dust. Other heavy dressings were also used and experimental plots laid down for future guidance. He kept no livestock. His own estimate of returns was £10 an acre on all crops over an average of years with a total cost of production of £7. 6. 6.

The system, he admitted, needed favourable conditions for success. Steam cultivation was a *sine qua non* and the landlord's permission to pursue a system of cropping opposed to custom, inconsistent to the accepted principles of good husbandry and supposed to exhaust and deteriorate the land.[18]

A little to the north Marshall was adopting a very different system to improve pasture on the Oxford clay and stonebrash. His farm was 297 acres of which 117 was pasture. He drained it all when he took the farm because he thought that grassland needed draining as much as arable. The first drains were 18′ apart and he had since put in intermediate lines. He fed corn and cake to beasts on pasture and found this effective in improving its grazing value. Farmyard manure had also produced a marked effect and he had used road scrapings from the oolite roads with advantage. His manure heap was enlarged because he kept his cattle in covered yards. He mowed one-third of his grass annually, the rest being grazed by cattle and horses till late in autumn when the ewes came on and remained till February getting pulped roots and chaff and the last six weeks ¼–½ lb. corn or cake daily. Under this system his grass paid better than before: from 1863–66 he kept 41 cattle worth £479: from 1871–74 he kept 53 worth £725 and his horses rose from 4 worth £37 to 8 worth £138.[19]

The systems of farming remained the same until the disasters of the later 70's and after because they were perhaps the best systems on which such land could be farmed but that is not to say that those systems were profitable. Men of Wiltshire, in the south at any rate, continued to buy the new implements. Charles H. Whatley a few years ago recalled the great excitement in the early 80's round Overton when he spent the day unpacking side delivery reapers and dispatching them to various farms.[20]

One of the farms at Lavington was equipped with double ploughs, elevator, steam threshers, pulpers and chaff cutters and corn grinding machines. It was most likely characteristic, but the bad weather and overseas competition had a disastrous effect on some of the large farms, and a great deal of the chalk down that had been so enthusiastically broken up had been laid down by 1880, or rather allowed to fall down, while round Devizes and in the famous Pewsey Vale many farms were to let. William C. Little indeed estimated effects of the depression as more severe in Wiltshire than in any one of the 10 counties he enquired into.[21] Middleditch's effort was breathed upon at a meeting of the Swindon Chamber of Agriculture on the 22 January 1880 when reference was made to a farm in the district where an attempt had been made to follow out Prout's system of continuous corn growing with disastrous results. Sheep losses in the 70's were from 773,986 in 1870 to 616,325 in 1880: cattle however rose from 83,475 in 1870 to 91,191 in 1879 and fell again to 86,969 in 1880 still a good deal more than the 1870 number and giving a clear indication of the trend farming was later to take in the county.

What had high farming achieved in Wiltshire? The report of 1844 shows that the systems had been stabilised by that date and that the main improvement was the introduction of steam ploughing in the south and the use of new implements there. Possibly the land was improved by the use of artificials, by more green crops and by feeding corn and cake: a good deal was drained but of none of these things is there any real measure.

### SOMERSET

Somerset is a county of greatly varied elevation and soils: so it was impossible that there should be any wide district of uniform farming like that of the uplands of Dorset and Wiltshire. The Vale of Taunton had, however, been famous for its fertility for three hundred years, its nature being summed up in the saying, "Bad for the rider, good for the abider." Lavergne subscribed to this usual opinion and remarked upon the excellent pasture which abounded round Gloucester and Bristol. Exmoor at the other end of the county was for him abandoned to a kind of half-wild sheep.

S. Mogg, a land agent at Bathpool, Taunton, did not think Somerset farming in 1848 was keeping pace with the most advanced counties although there were some outstanding farmers. A large area required field drainage, e.g., the grazing land between Bridgwater and Cross, and between Bridgwater and Dunster the land was better than the Vale of Taunton in his opinion and here there were men of capital and a firm making cheap pipe for drainage, but still the work did not get done partly because of insecurity of tenure and partly because there was little fall to the land and the outfalls were under the control of the Commissions of Sewers. Generally speaking the farm buildings were poor, but near Taunton some artificial manure and concentrates were used. The county had indeed always been famous for its use of lime some of which was bought across the Bristol Channel to the tiny ports like Watchet. The 4-course system was usual but the old 2 crop fallow was still to be found in the more remote hills. The cattle were Devons, Herefords and Shorthorns kept as stores; Leicester and Southdown sheep were kept sometimes crossed with Cotswolds on the best farms and Dorset Horns were kept for early lamb for Bath and Bristol,[22] a business that Rham thought

would be stimulated by the new railway.

Both Thomas Dyke Acland and William Sturge as well as an anonymous writer in the Somerset County Gazette of the day agreed with Mogg that there was a want of improvement in the marsh and peat moors, that the inferior grass lands should be broken up, that the enclosures ought to be enlarged and better accommodation for cattle to be provided.[23] Their work is very detailed and perhaps the best way to present its conclusions is to give brief descriptions of some of the notable farms mentioned in contrast to the general routine of the more commonplace. Though very complex the county can be divided into the Western District, the Middle District comprising the Vale of Taunton and Bridgwater and the Eastern District, Exmoor being quite a special and separate part.

On hills in the west excluding the then recently enclosed Exmoor farms varied widely in size from tiny holdings where farmers were little better off than labourers up to holdings of a few hundred acres occupied by men of capital and intelligence, but the district was very isolated. The smaller farms were worked on a species of alternate husbandry, traditional on such land for centuries, and to be found also in some of the wilder parts of Stafford, Shropshire and elsewhere. By this system the land was broken up, usually by paring and burning, and then cropped out. Formerly oats had been grown

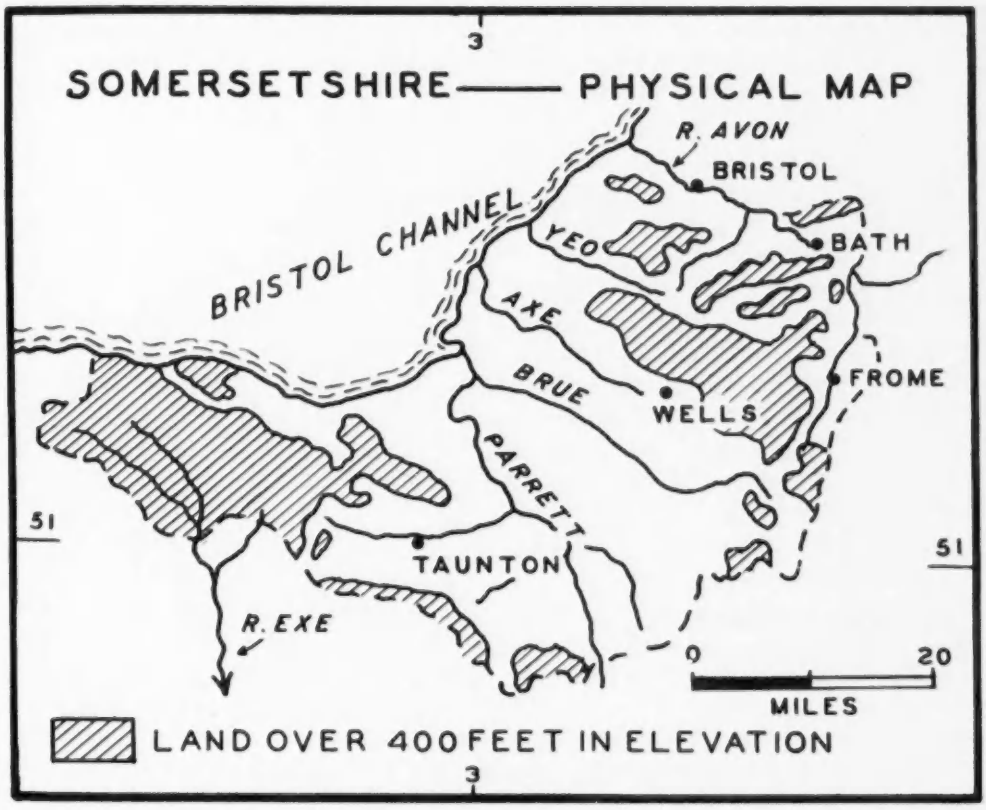


Figure 2.—The agricultural pattern, types of farming, fields and waste lands of Somersetshire conform so closely to its physical features that the latter may be interpreted from landscape. (From Thos. Dyke Acland and William Sturge, 1851.)

successively until the land was exhausted and the last feeble crop of oats was unable to survive the sea of weeds surrounding it and which went to form grazing as the land fell down to grass. The Rev. Bennett Michell, Rector of Winsford, who farmed his glebe, reported that this had been so far improved that on breaking up after a crop of oats "to clean the land"; wheat; turnips; oats or wheat; grass had become the common course. This had been further improved upon by Roals of Brendon Farm and Corner of Kings Brompton, both laying down after roots without a nurse crop, a system considered very desirable in that essentially rearing country. Blake of Venne House, Brendon Hill, had improved the farms on his estate by draining, liming, and sowing a carefully made selection of the more permanent grasses. He adopted this system of making valuable permanent pasture because he found his land unsuited to the growing of cereal crops. One or two people had recently made hillside water meadows with success in expansion of a system usual in the south west since the 17th century. Unfortunately cultivation of the turnip crop was very badly done, broadcast sowing, careless singling, and no hoeing being commonplace despite some good examples.

The livestock kept here were the famous Red Devon cattle and the Exmoor or Porlock breed of sheep, having small taper horns. Naturally the cattle breeding was closely allied to that of the adjoining district of Devonshire. Indeed Mr. Francis Quartly of Mollond Botreaux to whom the breed owed more than to any other man during the late 18th and early 19th century was on the boundary between the two counties. Two of Quartly's neighbours, Merson and Davy, had also kept up the breed for more than a century in 1850 and in West Somerset Hole of Knowle near Dunster had entered the field and spared no expense or trouble to breed the very best. The Somerset men were a little prejudiced in favour of a larger animal than Quartly and the Davy perhaps because they wanted it for labour before finishing as beef. In the Marshes the dairy cows were a mongrel lot but there were some good Longhorn dairies and a few Ayrshires. The Shorthorns found no favour except in the herd kept near Dunster by Risdon.

The sheep were the native Exmoors a famous breeder of these being Nurcombe of Minehead although he had many competitors. The Bampton Notts had been crossed with Leicesters and the Dorset Horns, slightly larger than the Exmoor, had recently been gaining ground.

On the high moors of Brendon Hill a Mr. Roals had reclaimed about 300 acres in the past thirty years making 240 acres of arable and 60 acres of meadow and pasture out of land formerly inhabited only by the Black Cock (Grouse?), but the large scale reclamation of Exmoor purchased by J. Knight for the Crown in 1818 was a major achievement the completion of which was only brought about well after 1850. By that date, however, roads had been made, the whole moor having first been enclosed, and 15 farm houses and buildings erected and about 40 cottages, 22 or 23 miles of road and 140 miles of fencing had been made, more still being in course of construction. Already it had been found that the climate was not only for ripening of grain, although in a favourable season large crops of oats could be harvested and green crops, grass, young stock and dairy produce must be the reliance of the Exmoor farmer.

On the Quantock Hills the system of

farming was much the same as that of the Taunton and Bridgwater districts. A Mr. Danger of Hunstile on the east of the hill had adopted a 5-course system despite steepness of his fields. All his green crops were horse hoed and the turnips carefully hand hoed by gangs of children, each gang 8 or 10 children under a woman supervisor. His sheep were grazed by day and folded at night in moveable sheds, not in hurdles. Mr. Hancock of Halse, another great breeder of Devon cattle, had effected great improvements in his Vale of Taunton farm during the first half of the 19th century, in buildings, grubbing useless hedges and marling. But though the Vale generally was worked on a 4-course system, the small fields and high hedges made yields of 15–20 bushels wheat an acre not uncommon; what was uncommon was the yield ranging from 20–25 bushels an acre reaped on some of the best farms. Fine bacon was made on the farm adjoining Halse, by Mr. Hibberd, and indeed pigs of the Essex and Berkshire breeds were kept throughout the county.

T. B. Morle of Cannington Park was another outstanding farmer and gave a good example to the whole of the Bridgwater area in the style of his management and the quality of his Red Devons. In this district value of the grazing land was very high. The best would fatten a bullock an acre in the summer and winter two sheep afterwards, but these graziers are not so wealthy since the introduction of mangolds and swedes. The second class grass produced cheese and was let in smaller farms of 50–120 acres a dairy of 30 cows making daily a good Cheddar cheese of about ½ cwt. About 3 acres was necessary to keep a cow and its yield was 3½–4 cwt. of cheese in a year. Few roots were grown and the dairy work was severely critisised by Mr. Yeoman of Dean Farm, West Cranmore. He grew clean roots, housed his cattle in winter, used a Cornes' straw cutting machine to prepare their bedding and fed straw chaff mixed with roots cut by Moody's turnip cutter. Several other names of good farmers in the part of the county abutting on Dorset could also be given but they had great difficulty with a very varied soil complex and it is impossible to give them all.

Besides the dairy work done in the Bridgwater Marshes and that neighbourhood the whole tract of the county north of the Mendip Hills from the Bristol Channel on the West to Bath and Frome on the east, the district south of the hills from Frome to Wincanton, thence west to Wells, Shepton Mallet and so to Sedgemoor was all devoted to that branch of farming and a great deal of the produce went to Bristol as fresh butter, although the south of the hills produced a vast quantity of Cheddar cheese then so much prized in the London market.

The county has, of course, always been famous for its cider and its special crops of teazles and osiers, the latter used for baskets and the former in woollen manufacture.

Twenty-five years later the same criticisms were levelled at Somerset farming. The general agriculture of the county was bad, the fences poor, the farm houses inferior and buildings dilapidated and the cottages defective, a very severe condemnation, but as in 1850 there were a good many individual well managed farms. One of these was that of George Babbage of Raleigh's Cross, 221 acres all reclaimed since he took it and lying on the 1300 foot contour. He breast-ploughed and burned the old growth, ploughed and removed the large boulders, limed for turnips and rape, took a couple of years crops and then seeded down but could only

maintain his ley for three years, it dying out in the third season. He kept 27 Devon cattle, 12 horses and colts and 200 Devon longwool ewes. He used a Hornsby manual delivery reaper and hired a portable steam thresher, both advanced things to do at that time.

Amongst the dairy farmers George Gibbons, Tunley Farm near Bath was a shining light. He had 155 acres pasture and 43 acres of arable worked on the 4-course system. He had tried the new phosphates, was not satisfied with them but was keen on conserving and using liquid manure. Salt was occasionally used as a top-dressing. Some hedges had been grubbed and he did most of his work by machinery. His dairy consisted of 48 Shorthorn cows, 14 yearling heifers and 2 bulls. He bought 100 in-lamb ewes in October, crossbreds with Hampshire blood, and drafted them as ready off the green crops. He kept 10 black Berkshire sows and a white boar and produced about 120 fat pigs per annum.

Obed Hosegood Dillington near Ilminster was a large scale farmer with 275 acres pasture and 140 acres arable worked on a system of wheat followed by 2 green crops in constant succession thus conserving a lot of fodder. He kept 72 cattle of all classes and a cross bred Shorthorn bull, 663 Dorset Horn sheep and 8 horses. He did not use a high average of the new artificials but some quantity of all of them, superphosphates, nitrate of soda, lime, salt and soot.[24]

J. A. Clarke in his essay on *Practical Agriculture* of 1878 (already cited) declared that farming west of the Quantock Hills was the same as Acland had described in 1850 and this A. Lovelace of Winsford near Dulverton confirmed in his evidence before the Agricultural Interests Commission in 1881. The north-eastern hills were largely permanent pasture grazed by dairy cows; but in Taunton Vale the old system of wheat, barley, grass for several years had been replaced by the 4-course and on the heavier land by a longer course of roots, including a few potatoes; barley; clover mown once and then fed off by sheep for 2 years; beans; white tares followed by rape both fed off by sheep; wheat. On the Bridgwater Level a wide variety of rotations was then current.

The major achievement in 19th century Somerset was the reclamation of Exmoor which although it did not change the wild Moor into a garden gave the countryside its modern face and created some farms where there had been none before. Before the enclosure was made sheep and pony stealing was rife on the Moors and smugglers used its hidden tracks to take their illicit imports far enough inland to make it safe for them to travel more or less openly. One local jingle ran:

> Steal the sheep and sell the wool
> Say the bells of Withypool.

And, of course, at an earlier day the district formed the setting for "Lorna Doone."

By 1875 and 1876 West country farmers were making a go of it on Exmoor farms. Where they had been accustomed to sell store stock to dealers they were then by virtue of a modified system able to sell to the butcher. The first men to take Mr. Knight's new farms had hoped to work them on the most approved system of their day, the 4 and 5 course system of the limestone and chalk downs where it had proved so successful. It did not work on the higher elevations and different soil of Exmoor but when the tenants changed and men reverted to the oats and grass economy of the similar farms

in other parts of the county they were able to thrive and to produce good cattle and sheep. The introduction of steam cultivation to break up and subsoil was of great assistance.[25]

A terrible story of the disasters of the late 70's in the dairy district of the north east of the county is told by S. G. Kendall in his *Farming memoirs of a West Country Yeoman* (1944) and is amply confirmed by W. C. Little's report to the Agricultural Interests Commission of 1881 except that on Exmoor where some Irish stores were then being imported for fattening depression was unknown, a tribute to the rectitude of the farming system there in face of its own physical difficulties and the economic and meteorological difficulties that had attacked it no less than the rest of the country.

For Exmoor there is a measure of what improvements had been made because there were farms there that were new in 1850; for the rest of the county all that can be said is that the system of farming remained very much what it was at the accession of Queen Victoria. Here and there all over the county were men of enterprise and capital whose work was an example to others but how far it was followed or indeed how far the other farmers had the power to follow it even if they had chosen to do so, is today to seek.

## Devon

None of the contemporaries, who wrote about it, was very enthusiastic about Devonshire farming in 1850 although Rham envisaged the same possibilities for it then as Vancouver had half a century before. He even went so far as to say that "on a general retrospect of Devonshire farming it must be allowed to be good, and yet it is capable of much improvement . . . when the meadows have been improved by judicious cultivation, and when a better system of convertible husbandry shall be more generally introduced; the soil and climate of Devonshire will make it one of the first counties for producing every kind of vegetable and animal food and the cultivation will extend to thousands of acres which are now looked upon as absolutely barren." But in spite of this optimistic prophecy the 24 by 20 square miles of Dartmoor have proved practically irreclaimable up to the present day.

The appearance of the county has always been of great beauty and this struck Elihu Burritt very forcibly in 1863. "In Devon," he wrote, "fields as red as brickdust, alternate with the green mosaic that covers hill and valley. When a strip of this soil is ploughed, harrowed, rolled and moistened by dew or rain, it takes a deeper red like varnished mahogany. Put a dozen strips of this background among fifty patches of wheat, oats, barley, beans and white clover, and you have a picture spread out before you that you will see nowhere else in England," but the allotments were all shapes and of little size. Burritt calls them morsels of land and says that "If the hedge had followed the path of a snake bewildered with excitement, it could hardly be more irregular." These high hedges and small fields naturally met with universal condemnation amongst the protagonists of "High Farming."

Many of the farms were small as is rather usual in grazing and dairy counties and the grassland was managed on the convertible system that had been traditional in the county for centuries. This was the system of taking a few crops and then letting the land revert to grass, and this also came in for censure: but on some of the large farms of 500 or 600 acres better practices

were in vogue. These were all too few.

Caird said roundly that there were many cumbersome and unskilful practices fifty years old. In fact they were probably much older: Henry Tanner thought that Devonshire farming was inferior to that of most of the counties of England. In their eyes this opinion may have been justified but perhaps the traditional system was wiser and more productive than they knew.

The "old Devon course" was turnips; wheat; barley; oats; seeds 2–6 or more years, and 6–8 hogheads of lime was harrowed in to the turnip land after fallowing, and then 10–12 two-horse cartloads of farmyard manure was spread and ploughed in, the turnips then being drilled on the flat. Such a course could not have been more than a century old in 1848, but was probably the same omitting the turnips before then. Potatoes had become an important crop in the county round Tavistock and Moretonhampstead where they were used as a first crop after breaking up the Moor, but disease then bade fair to reduce the area.[26] Few mangolds were grown although the crop gave high returns and carrots had not received the attention they deserved. Rape was grown by a few farmers. Wheat was broadcast because of the hills and not hoed or weeded: yet it gave an average yield of 24 bushels an acre. The first crop of grass was cut for hay and then it was grazed "until the land regains fertility."

Habit was strong and lime was said to be used too freely irrespective of the soil: in the north and west of the county seasand was considered equal to lime and indeed the seashells and other calcareous material included in it had much the same effect, being used at the rate of 11–13 two horse cartloads per acre on the arable. The farmyard manure was poorly managed. Drainage had received a good deal of attention, more especially on the larger farms. Improved implements like Lockwood's double turnwrist plough were used.

Tanner describes the livestock as Devons with some Guernseys or Somersets. Three years old steers were sold as working cattle, worked two years and then fattened, but the South Hams fattened their stores at three for the local trade and the Navy. The dairies, in which the renowned clotted cream was made, usually comprised 10–15 cows including one Guernsey. There were small hill sheep on the Moor but in the centre and east of the county the old Bampton breed was crossed with a Leicester or Cotswold ram, the ewes being sold at five years old and the wethers at 18 months or 2 years. The horses were small but strong and active. The pigs had been improved by crossing. He ends on the depressing note that the buildings were poor and a good homestead was rarely to be met with.[27]

Caird was a great admirer of the dairies and estimated that four-fifths of the county was in grass in 1850. Few roots or cabbage were grown but there was fine meadow hay and during the winter the cows, that Lavergne remarked as below the average in size yielding small quantities of milk but fine butter, were turned out for an hour or two daily in the orchards. Fatting cattle got 4–5 lb. cake daily with turnips, and they enjoyed a fine reputation. The cows gave 3 gallons a day making 20 ozs. of butter for the first 20 weeks of the calving. Cheese was made of the skim milk and porkers fed on skim milk or whey and fetched good prices.

Sheep were bred on most farms and the wethers, he said, sold at one year and were sometimes given a little cake when on the turnips. Lambing ewes were put on water meadows if available. Famous Devon cider, which yielded

15–20 hogsheads an acre of orchard and much more in some, was struggling against a drop of 50 per cent in prices within a few years. Potatoes, which were sent to London, had formerly been planted in lazy beds but by 1850 were planted in single rows moulded up. A seeding of 20 bushels an acre yielded three or four hundred bushels. Otherwise his report on Devonshire farming is similar to that of Tanner.

Some indication of the character of the Red Devon cattle has been given above. Their supposed natural habitat was in the district of the River Taw on West, from Barnstaple to South Molton railway station and so to Bampton, Wivelscombe, Taunton and thence to Williton and the Bristol Channel. After their adoption by Lord Leicester in 1800 and by Talbot of Temple Guiting in Gloucestershire and Childe of Kinlet Hall, Salop, high prices were realised and many of the best beasts sold away from the district and their former owners turned to the sheep and turnip husbandry. Some men, however, kept up the standards of their stock and improved it by careful buying, amongst whom Francis Quartly, already mentioned, figured prominently. Others were the Davys of Rose Ash and North Molton, Tapp and Buckingham of Twitchen, Mogridge and the Halses of Molland. The commencement of the Herd Book in 1850 also helped and a world-wide market was created. Devons were to be found on the Royal Farms at Windsor in 1869 and elsewhere in the United Kingdom and had been exported to Mexico, Jamaica, Canada, Australia, France and the U.S.A. Some opinion held that the breed was larger in the early years of the 19th century but were then lacking in quality, symmetry and depth of frame. Then the heifers often did not calve till they were four years old or more and their growth was unchecked. A wiser system of earlier breeding had corrected this. Heifers and yearlings went to Somerset to be fattened and stores were eagerly bought by graziers and dealers in Buckingham, Bedford, Cambridge, Leicester and Northampton and numbers were also sold at Barnet Fair, at Blackwater in Hampshire and Kingston on Thames, Surrey. The breed of cattle in the South Hams was larger and heavier and often pink or a yellowish colour and had probably a large admixture of Channel Islands blood. They were good milkers and carried an immense quantity of offal but although fattened on rich grazings had not been improved.[28]

The making of good pasture had more significance perhaps in Devon than in counties where cereal crops were the main source of income; and Alfred Tucker of Harburton in south Devon who rented about 250 acres had begun making improved pastures in 1867 and laying down some of the arable which was reduced by 20 acres of improved pasture in 1875. He also drained 22 acres of marsh, cropped it with the idea of laying it down to artificial grass. This land on which a first crop of oats failed was limed and then grew excellent green crops and wheat. Similarly another piece of poor heavy clay had always made a poor return in yield under crops and lost money, but then aided by a few dressings of dung and irrigated by a small stream had made good grazing. He was encouraged in these works by increased demand for meat at high price and uncertainty of growing good crops in a region of heavy rainfall. Increased cost of labour and low price of wheat were other factors to be considered, although grazing under his system required about 30 per cent more capital and a long lease and a good landlord.[29]

Although there was a heavy loss in

sheep owing to the seasons in the late 70's amounting to 21 per cent of the flocks or a drop from about 979,000 in 1874 to 774,000 in 1880 the depression had not hit Devon so hard as it had farmers more to the east. Notwithstanding the losses, almost complete failure of the cider crop for many years and great deficiency in the cereal crop of 1879, and that some of the largest landowners had not lost a single tenant, yet farming here as elsewhere had not been profitable. What bankruptcies had happened were not, however, caused by disastrous seasons and foreign competition but by failure of a well known West of England Bank.

The larger farms suffered worst, especially those worked on the 4-course system but those including 2 or 3 years ley, not so severely. In north Devon one explanation of stability in face of calamitous circumstances was that every tenant took a cart to market every week with pork, poultry, eggs, butter, fruit and vegetables and was not ashamed to pick up a penny or a halfpenny in that way as some of the larger farmers were.

There was no shortage of cattle in the county, the number being increased from a mean of 197,020 in 1870–71 to a mean of 226,075 in 1879–80, so this, one of the staples of the county's agriculture showed an appreciation rather than depression.[30]

Devon farming does not show much signs of change in its general outline during the period of "High Farming." Here as elsewhere there were a few outstanding farmers, mainly engaged in breeding the famous Red Devon cattle; but their ratio to the total was not high and it is difficult to conceive that farmers in the county were particularly affected by the propaganda of the day which was in the main directed towards the improvement of arable farming first by the introduction of the 4-course system to those light lands it had not reached in the 18th century and to the drainage and reclamation of the wet heavy clays to which the 18th century improvers had paid less attention.

### CORNWALL

Some considerable improvements had taken place in Cornish farming by 1850 but most of the county where arable farming was possible, continued to be worked on the convertible system of two or three corn crops, followed perhaps by rape and then let down, or on the better managed farms, laid down to grass for from 3 to 7 or 8 years. Potatoes were an important crop in many parts of the county and in some places two crops a year were obtained, the first in June the second in October. The yield was good, 100 sacks of earlies and 200 sacks of main crop per acre being usual.

When grass of convertible land was exhausted it was pared and burnt in preparation for cropping and a number of what may be called local manures used. Seasand and seaweed, or oreweed as it was named, were popular and to be had for the collecting. Lime was generally used and occasionally pilchards that had spoiled before they could be preserved.

The native cattle and sheep of the county had both been spoken of as small and the wool was kempy, but by 1850 the Red Devons had superseded the native breed of cattle and the sheep had been improved by crossing with the Leicester and the Cotswold.[31]

Some improvement in arable culture was made between 1815 and 1850 and particularly after 1835 by the extensive use of the turnip culture and the use of bone dust as manure and some drills for turnip seed and some combined drills were employed by 1845. More, the old wooden plough was then giving

place to iron ploughs perhaps not in "Ransome's best style, but nevertheless good implements." Scarifiers, cultivators and horse hoes were coming into fashion and there were some threshing machines many driven by water power and some by steam.

When the grass was broken up it was "ploughed to rot" in July, skimmed and harrowed and the weeds burned and the ashes spread. A second ploughing was given in October and occasionally lime at 100–150 bushels an acre spread just before this second ploughing. In other places a mixture of dung, earth and sand was applied at 70/80 loads an acre. The drilling was not general or even extensive and dibbling was unknown. Wheat, barley and oats in succession before the land went down again was usual although it was a considered opinion that some part of the county might be worked on the 4-course system; but there were great wastes like Bodmin Moor and tin mining had destroyed a lot of surface in other parts.[32]

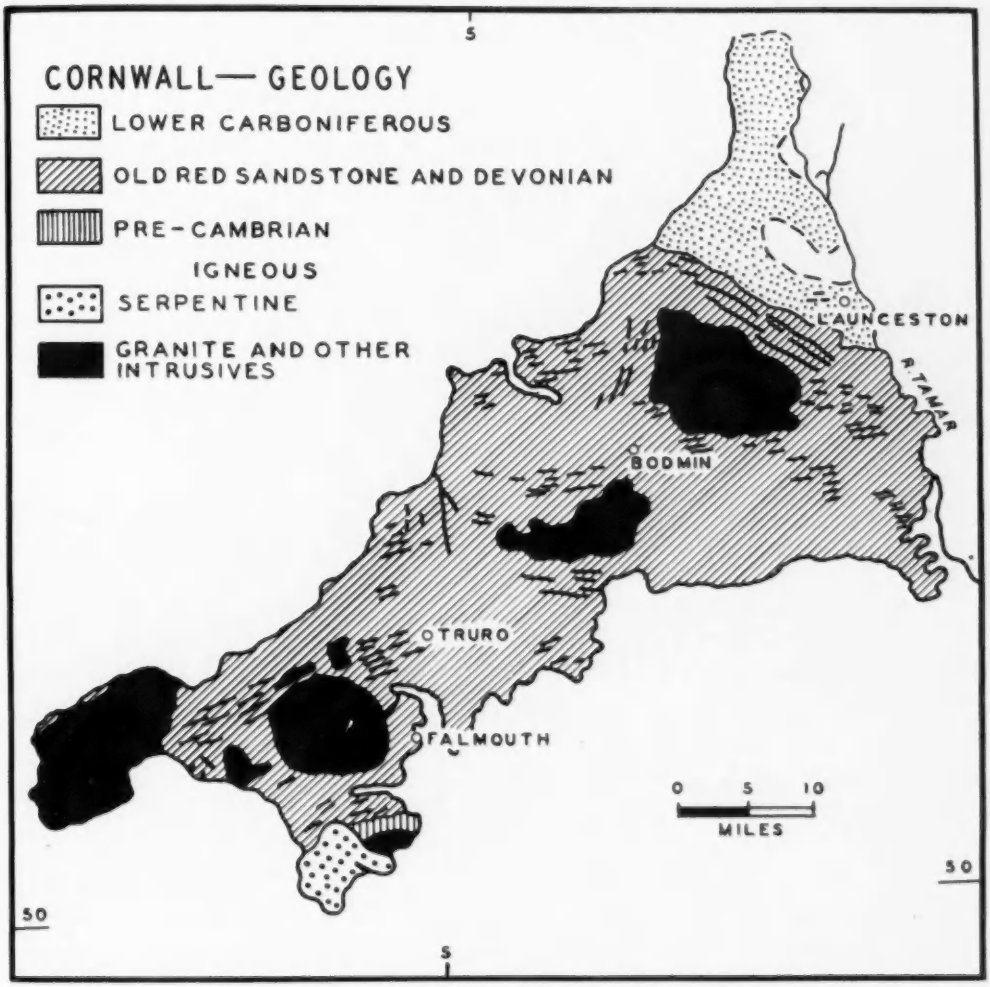


Figure 3.—Cornwall terrain as related to geological structure. The little agriculture there has been, and is, in Cornwall closely conforms in kind and degree to the terrain and soil. (From W. F. Karkeek, *Jour. Royal Agric. Soc. England*, Vol. VI, 1845–46.)

By 1878 it was possible to say that the agriculture of the county was now at a stage of general advancement, a great deal of small goods being produced on the small farms, dairy products, pork, potatoes and in some parts of the county market garden crops were grown: but the rotations still included a three year ley. The surface was then skim ploughed in summer, instead of paring and burning, given a late summer fallow, manured heavily with lime or

FIGURE 4.—An old-fashioned smithy in Hartland on the northwest coast of Devonshire. (From S. Bering-Gould "A Book of the West," Vol. I, 1899.)

dung, ashes and seasand and ploughed again for wheat sown in October, turnips or some other green crop followed and then barley or oats sown down with seeds for two or three years. This is perhaps one of the most definite improvements in arable farming practice it has been possible to indicate in the whole South-West of England. Potatoes also grew steadily more important and broccoli was planted when they had been gathered. Manuring with bones or guano was common for turnips.[33]

Livestock in the county did not suffer so greatly from the disasters of 1879 as in more eastern districts. Between 1871 and 1880 cattle increased from 137,623 to 163,604 and sheep increased from 363,905 in 1871 to 455,778 in 1879 decreasing only to 426,550 in the following year so the gain in cattle was large and the loss in sheep comparatively small. The general character of farming in the county remained in broad outline what it had been for centuries but was showing signs of what it was likely to become in the last part of the Victorian era.[34]

This is the contemporary evidence of "High farming in the South Western counties of England during the first forty years of Queen Victoria's reign." It shows that the improvements already incepted on the Dorset Downs had continued and were uniform and successful, that the same methods on the Wiltshire Downs were neither so uniform nor so unswervingly successful perhaps because local conditions were not so amenable, and that the dairy and stock-breeding districts of both counties made little change in their management although there were attempts to maintain and

FIGURE 5.—A cobb cottage at Sheepwash, a little hamlet of Devonshire. (From S. Bering-Gould, "A Book of the West," Vol. I, 1899.)

improve the livestock. So far as Somerset was concerned the reclamation of Exmoor was brought to success and the livestock industry made fine progress. The arable farming was confronted with greater obstacles and did not perhaps move so fast. Devon and Cornwall possessed a system of husbandry that the centuries had shown to be appropriate to their conditions and were loathe to change it materially. In both counties attention had been centred upon improvement of livestock.

But none of this gives any close statistical measure of progress; all that it gives is an idea that farming was not stagnant in any of these counties and that while the majority were content to go along jog-trot there were many outstanding men who were contributing their best to the general progress.

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# ALUMINUM RESOURCES OF THE UNITED STATES

*James E. Collier*

IN November, 1941, the United States Geological Survey estimated our known bauxite reserves at little more than 18,000,000 tons of commercially usable ore, plus about 11,000,000 tons of low-grade ore. From 1936 to 1940 we consumed on the average slightly less than 400,000 tons annually, and in addition imported almost an equal amount. On this basis, known resources then would have met our needs for about 45 years. Even meeting all our requirements from domestic production, known resources would have supplied our needs for 25 years. With approach of war, increased production, and at average annual rate of consumption during 1941–1945 (2,758,974 tons), they would have been exhausted in seven years. Our average annual imports during the five-year period were nearly one million tons. Meeting our total requirements from domestic reserves would have exhausted them by the end of the period.

Obviously something had to be done, and immediately. Three possibilities seemed to present themselves: (1) known resources might be extended by exploration leading to new discoveries, (2) improvement of current processes by which metallic aluminum was produced from bauxite to permit economic utilization of low-grade ores, and (3) utilization of nonbauxitic aluminous materials as sources of alumina and metallic aluminum.

*Additions by Exploration.* Most of the surface exposures of bauxite in the known areas of occurrence had already been determined and many of them mined to exhaustion. Exploration by geophysical and drilling operations had located some subsurface deposits, many of which had also been mined. The most likely possibilities of adding to known reserves of commercial ore was the latter method of determining deposits not easily discerned from surface manifestations.

Between 1941 and 1944 intensive exploration in the Arkansas bauxite region revealed 38 new bauxite and eight high-alumina clay deposits. The total merchantable ore discovered was about 23,500,000 tons, which more than doubled our proven reserves. In addition, over 34,000,000 tons of potentially usable submarginal bauxite and bauxitic clay were determined. Exploration in central Georgia revealed 1,000,000 tons or more of commercial grade bauxite in the Andersonville district; and determination of even larger quantities of low-grade ore in the area seems likely after additional drilling to outline extent of ore bodies of which existence has been determined. Additional study of other areas in the southeastern United States in which limited quantities of bauxite have previously been determined will undoubtedly extend reserves.

*Utilization of Low-grade Ores.* Commercially economical bauxite has until recently been considered to require a minimum of 50 per cent aluminum oxide content. In past operations using the traditional Bayer method of separating aluminum oxide (alumina) from the oxides of silicon, iron and titanium which occur as impurities in the ore, approximately one and one-half pounds of alumina has been lost with each pound of silica removed, and limited silica content of commercially economical ores to approximately 7 per cent.

In bauxites with less than 50 per cent alumina, either or both silica and iron contents are too high. Laboratory experiments have shown that some bauxite with as much as 12 to 15 per cent silica can be concentrated by flotation to contain only 6 per cent silica or less. It suggests possible lowering of the alumina content of commercial-grade ore.

During the war a previously developed, though not perfected process supplemental to the usual Bayer process was put into operation. It was the lime-soda-sinter process. It apparently making possible a recovery rate of 85 to 90 per cent or more of the total alumina contained in the ore; whereas a recovery rate of only 70 per cent can be realized by using the same ore in the Bayer process alone. As result of the improved process, high-silica ore which previously has not been economical can now be utilized. Its successful adoption should add several million tons of ore to our total commercial reserves and double the expected life of our deposits. The process is probably the major technologic advance of the past decade in the aluminum industry.

FIGURE 1.—Known aluminum resources of the United States in 1941, when bauxite and alunite were considered the only workable ores. At that date the U. S. Geological Survey estimated our reserves to be at little more than 18,000,000 tons of commercially usable ore, plus about 11,000,000 tons of low-grade ore.

makes it economical to utilize lower-grade ore. In the process red mud residue from the Bayer process, containing impurities and some alumina, is re-treated to remove additional quantities of alumina formerly not recovered,

*Possible Non-bauxitic Ores.* A third possible addition to the aluminum resources of the United States, yet to be realized, is successful utilization of non-bauxitic ores. Several aluminum-bearing minerals, such as alunite, leucite, and

anorthosite, as well as high-alumina shale and clay, are potential ores of aluminum. Alumina is extracted from nephelene syenite tailings of an apatite mine in the Kola Peninsula of Soviet Russia. A specially developed process reportedly permits extraction of potash and phosphoric acid as by-products which share production costs. Alunite is experimentally a source of alumina in the Caucasus region of the Soviet Union. Italy extracted alumina from leucite, but apparently not on an economical basis, since the plants were reconverted to use of bauxite. Attempted use of leucite as source of alumina in Japan had similar results.

The United States has also developed an experimental process for extraction of alumina from alunite, using a sulphuric acid process which produces potash and sulphur dioxide as by-products. A pilot plant was constructed near Salt Lake City in 1941. If successful, it could utilize the alunite deposits of several western states. Proven reserves of ore with alumina content of 30 per cent or more is less than 10,000,000 tons, however, enough to meet our total requirements of aluminum for only about three years.

In 1944 a plant designed to produce alumina from local clays was constructed at Salem, Oregon. Its estimated cost at the initial capacity was $75 to $80 per ton of alumina, as compared with the West Coast cost of $60 per ton for alumina produced from bauxite. Expansion of the plant should reduce production cost per ton.

Wartime exploration determined occurrence of extensive deposits of high-alumina clay in Washington, Oregon and Idaho which may be potential ores

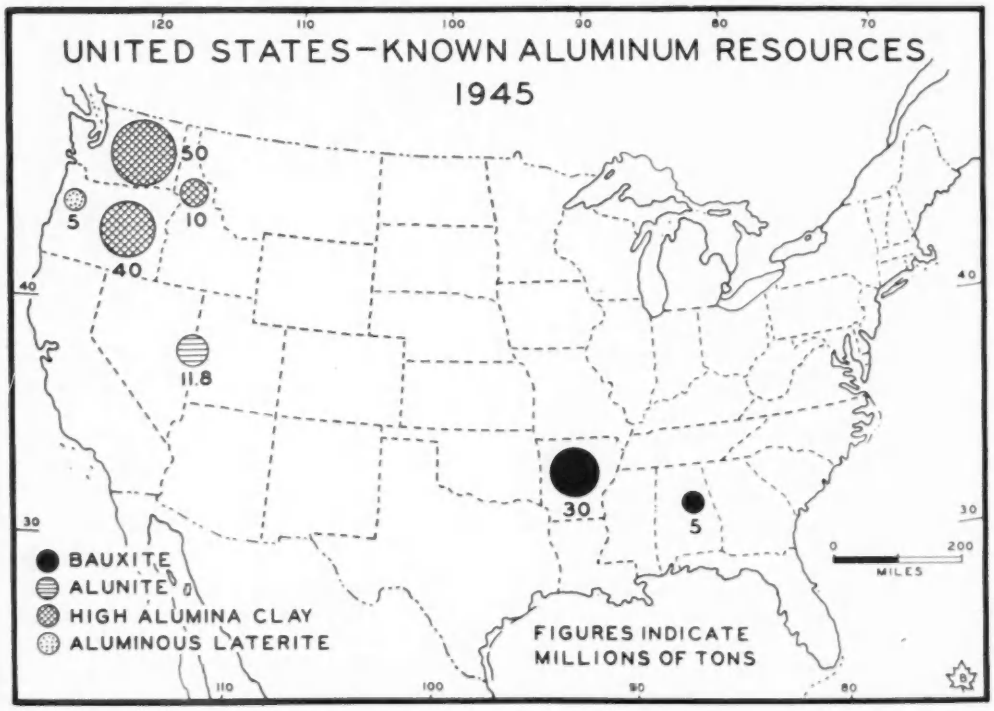


FIGURE 2.—Known aluminum resources of the United States in 1945, when new and improved methods of working aluminum ores, more than doubled the available reserves of bauxite and alunite and added millions of tons of high-alumina clay and aluminous laterite workable ores.

of aluminum. More than 40 million tons of such clay having alumina content of approximately 30 per cent and carrying from 3 to 8 per cent iron oxide have been determined in Oregon. Approximately 50,000,000 tons of similar clay have been determined in several deposits in Washington. In northern Idaho more than 10,000,000 tons of 25 per cent alumina clay are relatively near the Spokane, Washington, aluminum plant.

More than 5,000,000 tons of aluminous laterite are estimated to be contained in northwestern Oregon deposits. Although no plant is available for its utilization, aluminous laterite is considered to be a possible future ore of aluminum.

*Outlook.* From such various developments, realized or potential, it seems likely that the United States could in an emergency meet her requirements of aluminum from domestic sources. Not only did the war emergency stimulate exploration leading to new discoveries which greatly added to our known resources, but technological progress has also extended the life-expectancy of the reserves. In addition are known ores which will likely become economically usable by the time they are needed in the future. Furthermore, nondomestic sources of ore continued to be available during the war period, and probably will be in any future emergency.

A decline from wartime rate of consumption also improves the bauxite and aluminum supply position of the United States. From the peak reached in 1943 (5,332,151 tons), domestic consumption of bauxite declined 27 per cent during 1944 and an additional 30 per cent during 1945 (to 2,430,263 tons). Although further reductions in consumption no doubt have followed, or will follow, the rate may not return to prewar levels. By no means, however, is the outlook as serious as it seemed during the early war years.

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